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Cost of Steam and Water Power. WE print in another column an abstract of a report of the United States consul at Chemnitz, Germany, on the relative cost of steam and water power, which is of interest, although it should be borne in mind that the views expressed are probably not based upon professional knowledge, though the figures given seem to have been obtained from a reliable source. No harm is done by laying stress on the limitations of water power for the development of electric energy, but, on the contrary, a good end is achieved by calling attention to the fact that in many cases such power is dearer than steam. The popular impression is that water power costs nothing, the outlay for water improvements and plant not being considered, and as a consequence considerable harm may be done to the transmission of power branch of electricity through the financial failure of schemes which previous consideration of all of the factors would have at once shown were not feasible. Of all branches of engineering this is one which most demands the services of a competent engineer for preliminary studies. The matter should not be left in the hands of agents of electrical companies, whose main object of selling an electrical plant is likely to obscure their judgment in regard to the importance of the hydraulic features even should they be professionally qualified to deal with these.

Electric Heating and Welding. IN the Digest some further information is given in regard to the new method of electrically heating metals to a high temperature, and in another column is an item from which it appears that a public exhibition of the method was made in Boston as early as Oct. 12, 1892, by an American electrical firm. The method is one of unusual interest, and as the apparatus employed can be easily constructed by any one its commercial adaptability should soon be experimentally determined. As pointed out in our columns by Mr. Neher, the heating effect is probably due to arcs from the metal through a gaseous envelope to the conducting fluid. Should this turn out to be the true explanation it is at once evident that there will be considerable difficulty in controlling the intensity of heat, which will depend upon the thickness of the layer of gas; in addition, it would seem that with the violent action which occurs the gas coating is rather an unstable arc regulator. The abstract in the Digest refers to the adaptability of the method for tempering metals, and to the statement that with graphite rods a much higher temperature may be obtained than with the voltaic arc. As the highest temperature of the carbon in arc lamps is that of the vaporization of carbon, and therefore constant, it is not plain how a much higher temperature may be obtained by this method, unless the temperature of vaporization of graphite is correspondingly above that of carbon. If we are not mistaken, however, the same claim as to high temperate has been made with respect to arc lamp carbons similarly experimented with.

High Frequency Currents. AN explanation sometimes given to account for certain phenomena associated with alternating currents of very high frequency is that the flow of such currents is confined to the surface of a conductor. This explanation is a favorite one to account for the harmless effect of "Tesla" currents on the human body. It is true that an alternating current in a conductor is unequally distributed with reference to a section at right angles to the flow, the strength of the current being least at the centre and greatest at the surface. The cause of this may be considered to be that the electrical action in the medium surrounding the conductor has not time to "soak in," owing to the frequent reversals; or simply due to the inductive action of filamentary currents on each other, those in the centre of a conductor being most affected on account of their less mean distance from all of the others. This unequal distribution of the current increases the ohmic resistance of a conductor to an alternating as compared with a continuous current, but with frequencies such as those used in practice this increase is exceedingly small, and with currents of even millions of alternations per second the flow is far from being confined to the mere surface skin, as sometimes stated. In Heaviside's "Electrical Papers," a formula is deduced that enables the increase of resistance, which is a measure of the distribution of the flow, to be calculated for any current and conductor. For very high frequencies the formula reduces to the simple one of Lord Rayleigh, which is given in a number of electrical books.

The End. IN this issue we finish the report of Mr. Martin's case, and we think we have made good our promise to show that Mr. Martin had no grounds for complaint, even in morals, much less in law. Whoever was wronged by the actions which publication of the "details" of this case has brought to light, neither Mr. Martin nor Mr. Wetzler was. They had absolutely no cause for complaint, and were it not for the desire to accomplish some hidden purpose, which they would not admit, but which we think is now perfectly plain to anyone who has read all they said and did, this lawsuit would not have been begun. We are glad that our labors in publishing the story of Mr. Martin's actions are at an end, and also that we have been able to show that what he said and wrote about the paper and about Mr. Johnston was without truth or foundation, and that he knew this to be so at the time. This week's report gives what Mr. Wetzler had to say, and what he said is worth reading. Mr. Wetzler could not explain why he abandoned the paper on Feb. 8, 1890. He admitted that in the discharge of his duty he was in no way interfered with. He could not say positively whether Mr. Martin asked him to forsake his post on that night, but he thought not. Yet he offered no explanation why he did forsake it. When Mr. Martin slid away from duty and obligations alike, Mr. Wetzler, like a satellite, slid with him. As nothing, neither obligations to the company, to the advertisers of the paper, nor even to friends, could restrain Mr. Martin from going when spite or vindictiveness urged him to do so, neither could any of these prevent Mr. Wetzler from pursuing the same course when that meant to follow Mr. Martin. If there was anything further needed, beyond all that has been disclosed, to discredit this whole performance of Messrs. Martin and Wetzler, it is supplied right here in the total disregard they showed for all the obligations which were resting upon them. As Mr. Gallison, who was examined as a witness in regard to the duties of an editor, said: "The editor of a paper, I consider, is in the same position as the captain of a ship, and should see it properly in port before he leaves it." But no such obligation was recognized by either Mr. Martin or Mr. Wetzler.

The World's Fair and Other Exhibitions. Now that the World's Fair is a thing of the past, a comparison with previous exhibitions can be made fairly. Passing over the fact which every one knows and which this country has just reasons to be proud of, that the Fair was a grand and undeniable success, both financially and otherwise, let us compare some of the electrical features with those of former exhibitions. The Centennial of 1876 was the first large exhibition to contain any notable electrical exhibits, aside from telegraphic apparatus; there were only two such exhibits, but these may truly be said to have formed the foundation of the present electrical industry. One was the first exhibit of the telephone and the other a French exhibit of four arc lights run with Gramme machines. We remember them distinctly; they were one of the curious novelties of that exhibition and were looked at with awe, about as the World's Fair visitors looked at the high tension experiments of Tesla, Thomson and the Westinghouse company. The exhibition in Paris in 1878 contained somewhat more, sufficient to give birth to the idea of holding an exclusively electrical exhibition in that city in 1881, which was the first of its kind, and showed the public what a revolution electricity was making in lighting and in the transmission of speech. The wonderful accomplishments, chiefly of the Americans Edison and Bell, were the marvel of the time, and it may well be said that this exhibition opened the electrical field to many investors, inventors, and, we regret to say, to unscrupulous promotors; it also gave rise to the present excellent system of units, which was adopted at that time. During four years electrical exhibitions were the rage, and became annual occurrences. In the one in Munich, in 1882, the subject of the transmission of power was the chief matter of interest, and created that famous and almost endless discussion. At Vienna, in 1883, there was nothing especially new except the first suggestion of the use of high tension alternating currents and transformers; electrical engineering was then no longer an infant, but had become a large commercial industry and a very successful one. At Philadelphia, in 1884, Americans had an opportunity of showing the great progress made by them, the foreigners being apparently too tired of electrical exhibitions to make any contribution; although interesting and attractive there was nothing particularly new. Next came the grand Paris Universal Exhibition of 1889, which was the first of the universal exhibitions in which electricity took a most important part. Electric lighting, the distribution of power and the telephone may safely be numbered among the leading attractions which made this exhibition as interesting as it was. Then came the Frankfort electrical exhibition of 1891, which is still fresh in the minds of many, especially on account of the successful exhibition of the transmission of power over an exceedingly long distance by means of very high voltage multiphase currents. Finally the World's Fair; what this would have been without electricity would be difficult to say; but there is little doubt in our mind that, without the numerous attractive features and facilities afforded by the use of electricity in many ways, this eminently successful exhibition would have been without the charm that attracted many of the 23,000,000 visitors, and enabled the managers to pay all their debts and have a million or two profit. Imagine the Fair without the electric lights, the electric motors, the electric railway, the Electricity Building, the electric launches, the electric search lights, the electric fountains, etc.! Without these attractions the Fair would have been cold and quiet. This fair, more than any of the others, shows how electricity has revolutionized exhibitions. It would have been closed when the sun ceased to exhibit itself, and many of the exhibits would probably have been destroyed by fire from gaslights in the wooden buildings. It may be said to have been lacking in great revolutionizing improvements and inventions in the electric fields, and the electric fountains may justly be said to have been inferior to those of Paris, but that electricity did not take a most important part, and the part which made the Fair a success, not even the most pessimistic can claim.

Simple Method for Correcting Resistance for Temperature.

BY CARL HERING.

Instead of using the usual formula for correcting the resistance of copper wire for temperature, the calculation may, in certain cases, be very much simplified by the following method, which, although it has already been published,* may not be generally known. It applies when the resistance of a copper wire at a given temperature is to be calculated from its length and diameter. Instead of correcting it for temperature simply, use the value of K, from the accompanying table, for the nearest temperature, and calculate the resistance from the formula $R = K\frac{L}{d^2}$. In this formula L is the length in feet, d the diameter in mils (or d^2 the cross-section in circular mils), and K the mil-foot specific resistance for that temperature. As will be seen, the table has been so prepared that the value of K contains only two digits, one of which is unity, thus making the calculation a very simple one.

The table is based on the Matthiessen standard suggested by the Committee of the American Institute of Electrical Engineers, namely, 9.612 legal ohms for one mil-foot at 0° C.

K	Temp. in Fah. degrees.	Temp. in Cent. degrees.	K	Temp. in Fah. degrees.	Temp. in Cent. degrees.
10.0	50.5	10.3	10.8	86.9	30.5
10.1	55.2	12.9	10.9	91.3	33.0
10.2	59.8	15.4	11.0	95.7	35.4
10.3	64.4	18.0	11.1	100.0	37.8
10.4	69.0	20.5	11.2	104.4	40.2
10.5	73.5	23.1	11.3	108.6	42.6
10.6	78.0	25.6	11.4	112.9	45.0
10.7	82.5	28.0	11.5	117.1	47.3

A New Method of Electric Heating.

The method of heating metals by immersion in a liquid, and the passage of a strong current through it, which has been creating quite a sensation, both among electricians and metallurgists, has already been mentioned and described several times in our columns. There seems to be some discussion as to whether it was first invented in this country or abroad. We have information which, for obvious reasons, cannot yet be published, but the following extract from a Boston daily paper dated Oct. 12, 1892, shows that the process was exhibited in that city at that time by the Burton Electric Forging Company:

"The most remarkable exhibition was the heating of a bar of iron to a red heat in water. A current was passed through an ordinary pail full of water, and the iron on being plunged in became red hot in less than 30 seconds. The current was then turned off and the iron cooled in the same pail of water."

The Action of Electricity on Microbes.

The methods employed by M. D'Arsonval to determine the action of electricity on living matter have already been noticed in these columns. The process consists essentially in passing a current through a solenoid, in the interior of which the substance to be experimented on is placed. MM. D'Arsonval and Charrin, according to the "Lancet," recently made some investigations as to the effects produced on microbes by the current; selecting for this purpose the Bacillus pyocyaneus. A culture of this organism was placed in the solenoid. At the commencement of the experiment a tube of nutrient agar-agar was inoculated with two drops of the culture. After the lapse of ten, twenty and sixty minutes respectively, further cultures were made on different tubes, which were all placed in an incubator for some hours. An examination of the tubes then showed that a luxuriant culture of the bacillus had grown in each; the forms of the colonies had undergone no change, and were similar to those grown in central tubes; the pathological characteristics appeared also to be the same. The color of the cultures, however, had been to some extent affected; for while in the first two tubes the organisms exhibited an intensely green color, which was scarcely less vivid in the second than in the first tube, the color in the third and fourth tubes was much less marked. These experiments seemed to show, then, that the electric current had some effect upon the organisms, although the action was not very marked. Further investigations in the same direction would be valuable, and might possibly throw some light on the electrical state of the atmosphere as affecting the course of certain epidemics.—London "Electrician."

Storage Batteries in Commercial Work.

The excellent article on this subject which appeared in the last issue of THE ELECTRICAL WORLD was credited to J. Arnold. This was a typographical error and Mr. J. Appleton is the author of the article. Mr. Appleton has had wide experience in this field in England and being thoroughly familiar with the various types of batteries used abroad is peculiarly qualified to write upon this subject.

* In the author's "Wiring Computer," p. 32.

Laboratory Notes.—IX.

BY LIEUT. F. JARVIS PATTEN.

Fig. 12 gives the diagram of circuits and general arrangement of a convenient switchboard for such a system of laboratory circuits as have thus far been described. It is not assumed that the ammeters and voltmeters will be upon or even near the switchboard, as might be implied by the diagram. They are simply indicated on the board to show where their connecting circuits are introduced. The specific construction of the rheostats, $R\ h_1$, etc., will be more particularly referred to under the proper heading, as indicated in the diagram. They represent liquid resistances, consisting of a vessel having plates connected to terminal wires plunged into some conducting liquid contained in the vessel—a most convenient form for general use. The larger switches are indicated as two-way or three-way jackknife switches, as the circumstances require, with movable lever handles, and preferably, I think, without spring action for larger sizes, say, those carrying upward of 25 amperes. The wavy lines at points $f\ f$ on the board indicate fuse plugs or fuse wires of suitable carrying capacity, which, at the risk of continued repetition, I must again remind you should be introduced into every circuit in your workshop without any exception, as there is no more certain way to insure an accident of a more or less serious nature than to depend upon your personal knowledge of the circuits you have made and your expert faculty of carrying a mental diagram of every circuit in your head.

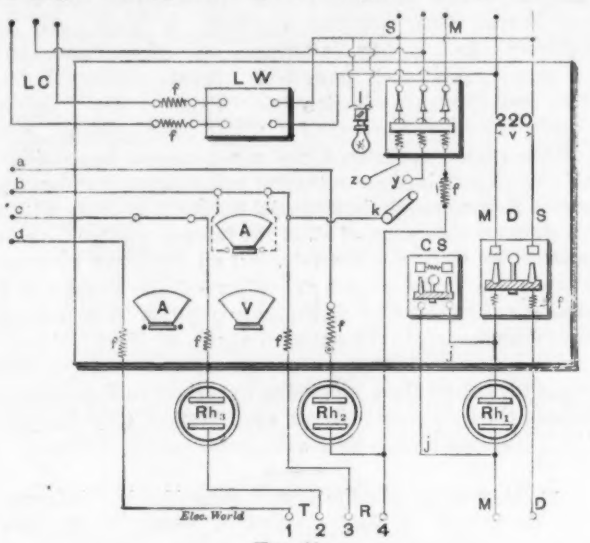


FIG. 12.

Coming from the street or the dynamo in the basement are the 220-volt street mains, $S\ M$, and a middle wire between which and each outside one you have a pressure of 110 volts.

From these branch various circuits, as shown, first the light circuit $L\ C$, to which the lamps that light your establishment are connected, must necessarily be independent of all others, and passes through a light switch, $L\ W$, which may be a 30-ampere snap switch, but it must be a double pole switch, as it makes the two outside wires continuous on closing the middle wire at $L\ C$, being left unbroken from its connection to the middle house main. Another light circuit, indicated at I by a lamp, is taken off between the switch and the connections to the mains, so that you may have a light at the switchboard to look at connections behind or any such matter without turning on all the lights in the shop. It is an independent light circuit, and may be conveniently led outside the shop in some cases for hallway lighting and the like when all the other shop circuits are necessarily turned off. These features are extremely simple and might be passed over without reference, but it has been deemed advisable to refer to them to insure getting the circuits of a shop started right. If you go to work putting in one circuit here and another there, as the occasion for their use arises, a jumble of circuits results that must sooner or later lead to confusion and mistakes. The circuits you have to put in and take out in the course of but little experimental work will keep you busy enough holding mental track of things, and for this reason, if

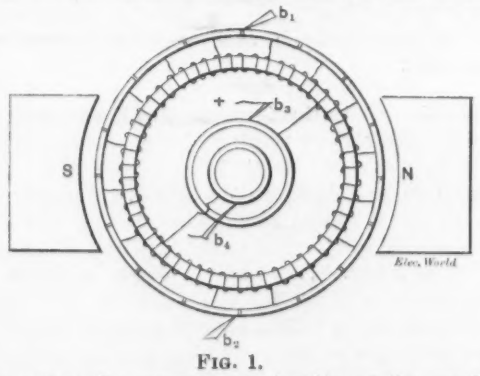


FIG. 1.

for no other, the permanent circuits of the workshop should all be predetermined and arranged in some such manner as that indicated before work is begun.

To the right of the mains $S\ M$ are the two leads to the motor dynamo of the shop connected to the two outside wires if you have a 220-volt motor. A large independent switch with fuses is placed in this circuit, indicated at $M\ D\ S$, and a rheostat, adjustable, of course, is placed in this circuit, shown at $R\ h_1$; around this rheostat, however, a shunt circuit is indicated at $j\ j$, which passes through the switch $c\ s$, by which this resistance may, if desired, be entirely cut out of circuit.

The use of this will be evident if you consider two different uses already indicated for the motor dynamo.

First, that shown in Figs. 1 and 2 of the fourth paper.* They show an alternating current working circuit which is in parallel or in multiple arc with the

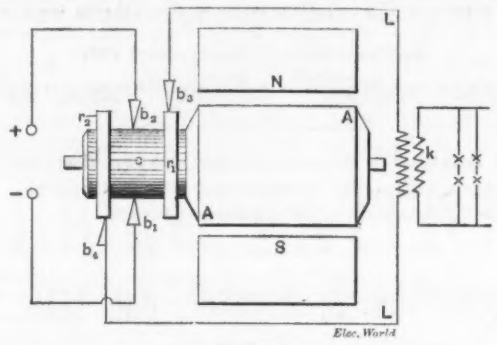


FIG. 2.

armature circuit itself. If, now, this external circuit should be closed through a very low resistance or accidentally short-circuited, there would be great danger of injury to the motor or to the apparatus so placed in circuit, unless the fuses were instantly blown so the rheostat $R\ h_1$ is introduced in the working machine circuit in all such cases. If, however, the full working current is required in the machine, after starting up, the cut-out switch, $c\ s$, is closed.

If, on the other hand, the motor dynamo is connected up as indicated in Fig. 10, the working (motor) circuit

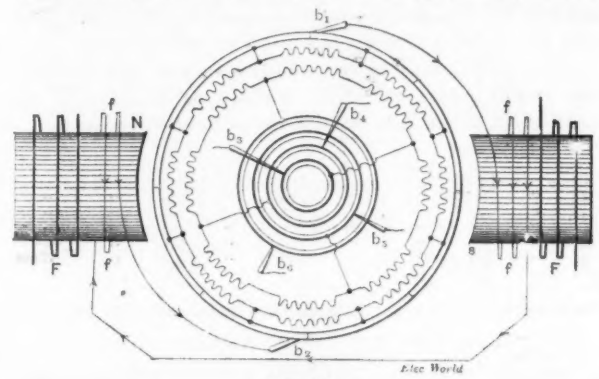


FIG. 10.

of the machine is independent of the external working or dynamo circuit, the rheostat $R\ h_1$ will be found superfluous in the machine circuit, but should then always and for the same reasons be placed on the external working or dynamo circuit of that type of machine. As an illustration of this, referring back to the "Brush" type of motor dynamo indicated in Fig. 12, let us suppose the dynamo or alternating current circuit open, and you have a 220-volt working motor circuit. You may close this circuit on the machine of course by throwing the switch $M\ D\ S$ on the switchboard and the motor will run at its maximum speed, being light, but if you take a piece of wire and short circuit the brushes of the dynamo circuit, unless the wire is instantly melted, you will throw such a load on the machine, practically a mechanical load, though the work done is instantly transformed into electrical energy, and this into heat—that you will stop the machine in all probability and risk burning its armature out, as you then have no reactive counter E. M. F. in your motor armature. When this is done by accident the fuse plugs will save disaster if they are in place. The mains $M\ D$ then go to the motor dynamo and give it the power it uses mechanically or transforms to other current. The four rings of this machine that yield the single or double alternating currents are then connected by their brushes and leads to the wires 1, 2, 3, 4, at $T\ R$ on the switchboard, which brings our working circuits under control at this point. Entering leads 1 and 2 are one alternating circuit, and the leads 3 and 4 are another. Both are used for biphase currents, and either pair alone, if you want a single alternating current. Let it be remembered that if your motor dynamo is working, say, up to maximum power, the single alternating current given off, if but one pair of leads 1 and 2 are connected, will be the equivalent in energy to the two biphase currents you would get were both pairs of leads connected. So, under all circumstances, it will be found advisable to have independent adjustable resistances $R\ h_2$ and $R\ h_3$ in both these circuits; and to be certain of a balance when both are used on the apparatus in circuit these resistances also may well be provided with cut-out switches.

From the switchboard these mains indicated at a, b, c, d, which are the working alternating current mains, go to the translating devices under investigation. At convenient points in these circuits, however, on the switchboard, suitable connections are made for the ammeter and voltmeter circuits usually required.

(To be continued.)

* THE ELECTRICAL WORLD, Sept. 30, 1893.

Rope Driving.—II.

BY J. J. FLATHER.

The manner of distribution of the power to the several floors of a mill is shown in Fig. 1, which represents a plant recently designed by Messrs. Lockwood & Greene, of Boston, for the Lanett cotton mills, West Point, Ga., in which 1,100 h. p. is delivered from the engine by means of twenty-six 1¾-inch ropes. The flywheel is 26 feet in diameter, and makes 60 revolutions per minute, corresponding to which the velocity of the rim is 4,900 feet per minute. As will be seen from the figure, the driver sheaves are placed in a well in the middle of the factory, and the line shafts extend to the right and left, as shown.

There is no line shaft on the second floor, as the various machines may be driven from below.

The distribution is as follows:

ROPE DRIVES IN LANETT COTTON MILLS.

	Number of Ropes.	Dia. of Rope. Inches.	Dia. of Pulley. Inches.	Revolutions of Pulley per minute.	Horse power.
1st Floor.....	8	1¾	81	231	336
3d Floor.....	7	1¾	62	302	294
4th Floor.....	11	1¾	62	302	462

A system of main driving ropes arranged by Messrs. Hick, Hargreaves & Co., Bolton, England, for distributing power to the different floors of a cotton mill is given in Fig. 2, which shows an elevation in section of the rope chamber and engine house. There are in this case five floors, which are supplied with power through 35 cotton ropes 1⅝ inches in diameter. The engine is a horizontal Corliss of 1,100 h. p., with a rope wheel 26 feet in diameter, the speed of the rim being 4,490 feet per minute. The power is distributed by six groups of ropes to six separate shafts, from two of which power is transmitted by additional ropes and pulleys to four other shafts, making a total of 10 shafts driven directly or intermediately from the rope chamber.

The distribution is as follows:*

ROPE DRIVE IN ENGLISH COTTON MILL.

Floor.	No. of Pulley.	Diameter of Pulley.	Revolutions per Minute.	No. of Ropes.	Dia. of Ropes.
Ground Floor....	1	8 ft. 3	173.3	4	1⅝
" "	2	8 ft. 3	173.3	5[1]	1⅝
No. 2 Room.....	3	5 ft. 8¾	250	5	1⅝
No. 3 Room.....	4	5 ft. 8¾	250	7[2]	1⅝
No. 4 Room.....	5	5 ft. 8¾	250	7	1⅝
No. 5 Room.....	6	5 ft. 8¾	250	7	1⅝
Total number of ropes from flywheel.....				35	

[1] From a pulley of four grooves on the same shaft, 8 ft. 3 in. diameter, power is transmitted to two pulleys, 6 ft. 4 in. diameter, by two ropes for each, making 225.7 turns per minute.
[2] Two pulleys, 5 ft. 8¾ in. in diameter, are driven by two ropes to each from No. 4 pulley.

In these examples the multiple rope system is used, each wind consisting of a separate rope stretched around the flywheel and its individual shaft pulley, then spliced. The degree of tightness will depend upon the material of the rope and the amount of tension in the slack part necessary for adhesion. In many cases the initial tension is very small compared with the strength of the rope—especially so where the horizontal distance between driving and driven pulleys is great, as, under such conditions, the tension in the slack side due to the weight of rope in the hanging catenary is often sufficient to prevent slipping; a slack upper rope in horizontal or inclined drives will also increase the arc of contact, thereby increasing the grip of the rope.

This is shown in Figs. 3 and 4, which represent two pulleys of equal diameter, arranged as in the upper figure, to drive with the slack side uppermost, and, in the lower figure, with the slack side below.

*Clark's "Steam Engines," Vol. III., p. 247.

The difference in the arc of contact, as shown in the figures, is 60 degrees, which would, under similar conditions, produce a difference of over 25 per cent. in the amount of horse power transmitted by the two ropes.

New cotton ropes are generally stretched as taut as possible on account of their extensibility, as they will soon become slack enough for good working and may even have to be re-spliced before becoming permanently set.

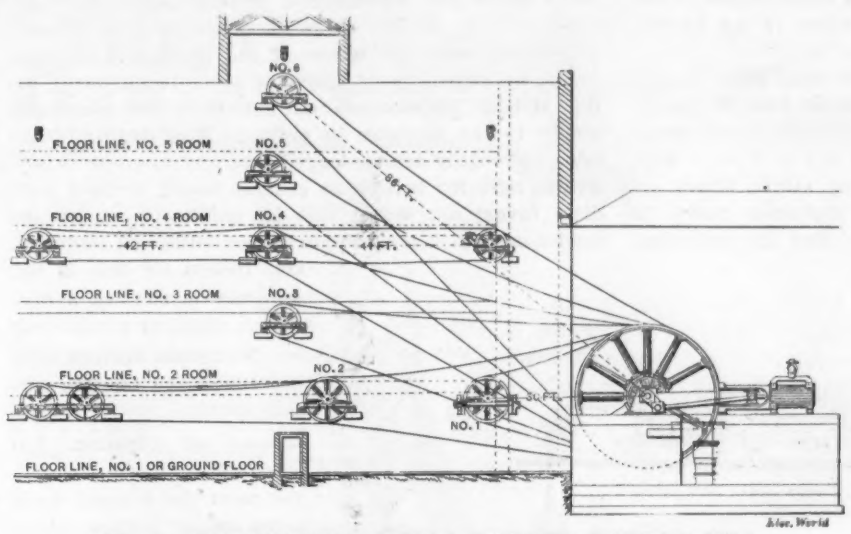


FIG. 2.—MAIN DRIVING ROPES—ENGLISH COTTON MILL.

It is the practice of some engineers to strain both manila and cotton ropes as much as possible and unite the ends with a temporary short splice when first put over the pulleys; after running a few days a permanent stretch is given to the rope, which is then re-spliced with a long splice, the strain on the rope being very much reduced in this latter case.

A good example of the American or wound system of rope transmission is shown in Fig. 5, which represents a plant designed by the Link Belt Machinery Company and erected for the Western Electric Company, New York. In this case vertical ropes are used, which are arranged to transmit the power of two 200-h. p. Russell engines, cylinders 18 by 27 inches, making 125 revolutions per minute; flywheels 10 feet diameter, each turned with eight grooves for 1⅛-inch rope. The ropes are of rawhide and wound continuously around the pulleys. As the rope leaves the flywheel at the left-hand side it runs over an idler, and from thence to a tension pulley, or tightener, which is suspended in such a manner as to be drawn back by the weights, as shown. The arms which support the tighteners are hung from rollers, which are grooved to fit the surface of a section of extra heavy wrought iron pipe, upon which they roll. From this tightener the rope passes direct to the right hand groove of the pulley on the main shaft above the engine, the tightener pulley being inclined sufficiently to make the bottom come in line with the left hand, while the top comes in contact with the right hand groove.

The main pulleys which drive the shaft above the engines are mounted upon and keyed to sleeves 10 inches diameter, which extend out on each side far enough to form journals, by which they are supported in pedestals independently of the shaft. Through the sleeve is a hole considerably larger than the shaft which passes through them and which is supported by separate pedestals. One end of each sleeve is so formed as to make, in connection with a sliding collar which is on the shaft, a positive interlocking clutch, which can be thrown in or out by a lever. In this way both engines may be working at the same time, or the shaft may be run by either engine alone, the other pulley standing and imposing no friction upon the shaft. All the bearings of this shaft are adjustable laterally by set screw and vertically by wedges. The other large pulleys upon this shaft are driven by friction clutches, and are used for driving dynamos, each pulley driving two dynamos arranged "tandem," one belt running over the other. This shaft runs at 220 revolutions and is 4½ inches diameter. At one end of the main shaft is a pulley having 12 grooves, in which run two ropes side by side to the top of the building and around the various pulleys down again. Either of these ropes is calculated to be amply strong enough for the work, but two are used to avoid the necessity for stopping should one break. Each of them winds three times around the pulleys, thus giving six driving strands. To avoid crowding, the tightener for one of these is placed upon the floor above the other. The ropes pass from the main pulley three times around the pulley above and then go to the floors above, as indicated. From the shafts, the wood-working machinery, blowers for the foundry, and some of the elevators are operated; the other lines being used for driving light machine tools, such as are used in making electrical apparatus.

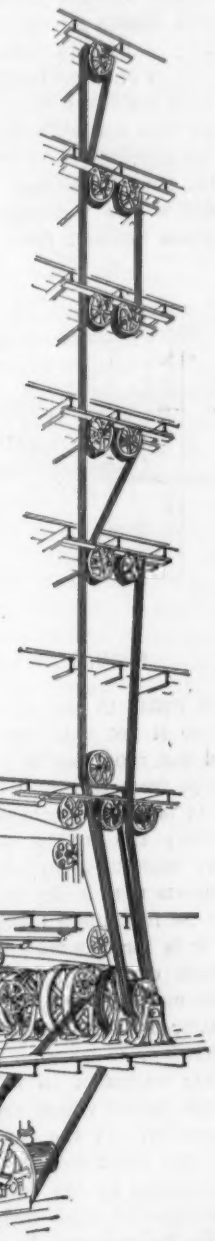
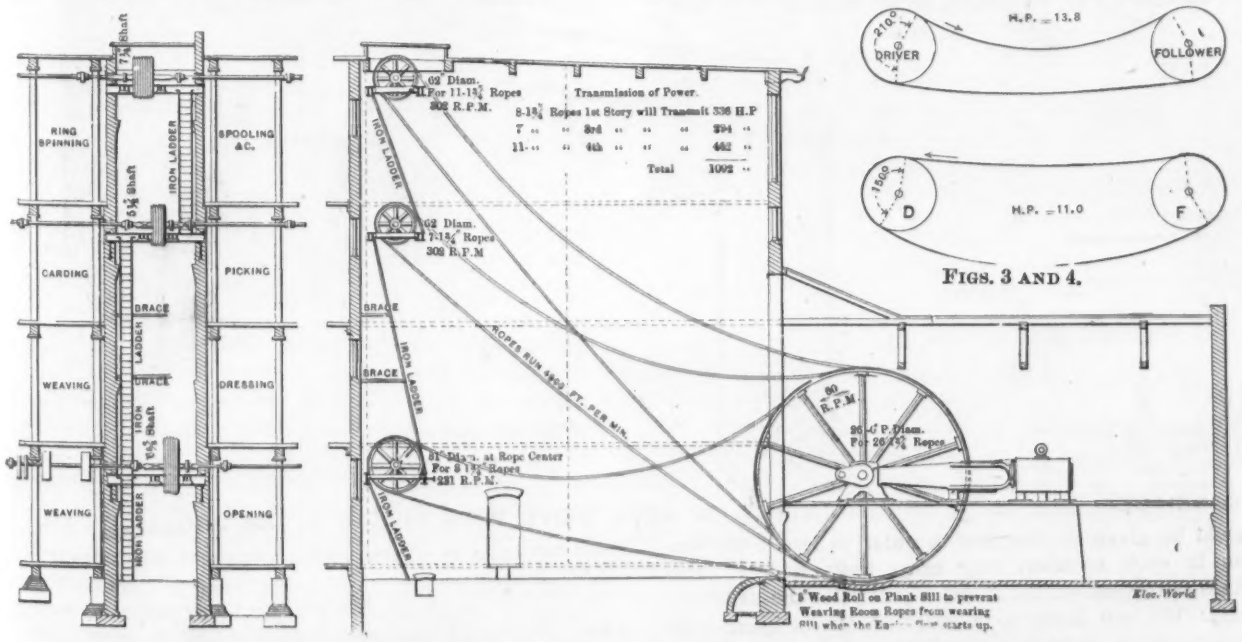


FIG. 5.—AMERICAN OR WOUND SYSTEM OF ROPE TRANSMISSION.

Each floor has a cut-off coupling, which is so arranged that in case of accident it can be cut off at a minute's notice, or when running overtime any floor can be cut off, thus saving the cost of running any more machinery than is necessary.



FIGS. 3 AND 4.

FIG. 1.—METHOD OF DISTRIBUTING POWER TO SEVERAL FLOORS.

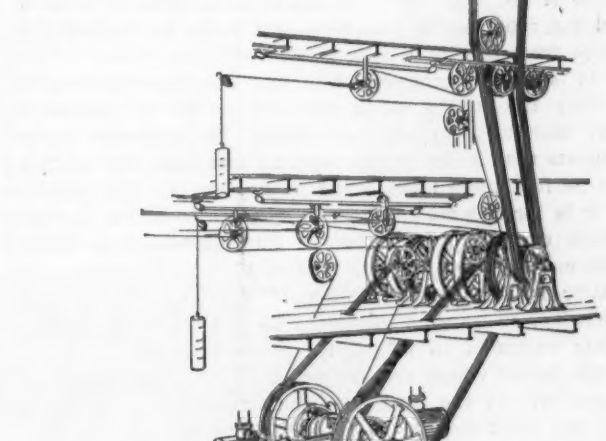


FIG. 6.—TIGHTENER FOR ROPE TRANSMISSION.

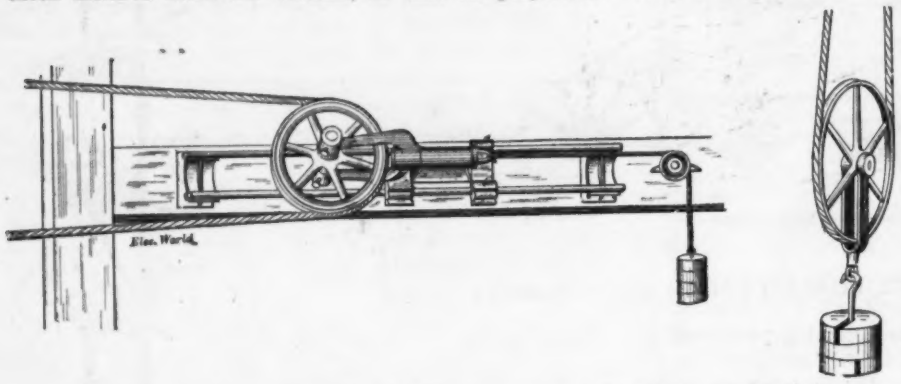
The use of the tension carriage plays an important part in the American system of rope transmission. As usually made, it is automatic in its operation, and so weighted as to give a constant tension to the rope, as indicated in Fig. 6. In this arrangement an initial tension is given and maintained by the automatic tension carriage, which is free to move backward or forward on a horizonal track as the load changes, or the rope stretches, always taking up the slack and maintain

ing the proper tension. Another form of tension carriage is that shown in Fig. 7.

In this case the carriage is mounted on gaspipe or solid shafting and is provided with ball bearings arranged with cast pockets so that the balls are allowed to circulate lengthwise of the bearings.

An arrangement of light angle iron tracks supporting a four-wheeled carriage is used to a considerable extent and makes an excellent tightener where it can be employed, as it is cheap and readily set up.

It is obvious that vertical tensions may be arranged in a similar manner to those shown in Figs. 6 and 7. In such cases the weight may be suspended directly from the carriage or even the sheave, as in Fig. 8, or it may be led off in any desired direction either above or below the tightener pulley. The tightener pulley is often inclined from the vertical, so that its projection



FIGS. 7 AND 8.—TENSION CARRIAGE AND VERTICAL TENSION.

is equal to the width of the driving pulley, in which case it not only serves to maintain a constant tension in the rope, but it thus acts as a guide to conduct the rope from one groove to another.

It is a well recognized fact that atmospheric changes affect the length of a rope, which, in the presence of moisture, always contracts. Experiments have shown that a dry hemp rope 25 feet long will shrink to 24 feet upon being wet.*

It is for this reason that, in addition to taking up the slack caused by variation in load, provision is made for maintaining a proper tension in the rope when the latter is variable in its length, due to atmospheric changes, or becomes elongated as it loses its elasticity. This variation in length is particularly noticeable in rope drives which are subjected to exposure from the weather. As the initial tension, which gives adhesion to the slack side of the rope, varies with the weight supported by the tension carriage, it is obvious that an increase of this weight will increase the power which may be delivered by the rope. As, however, the horse

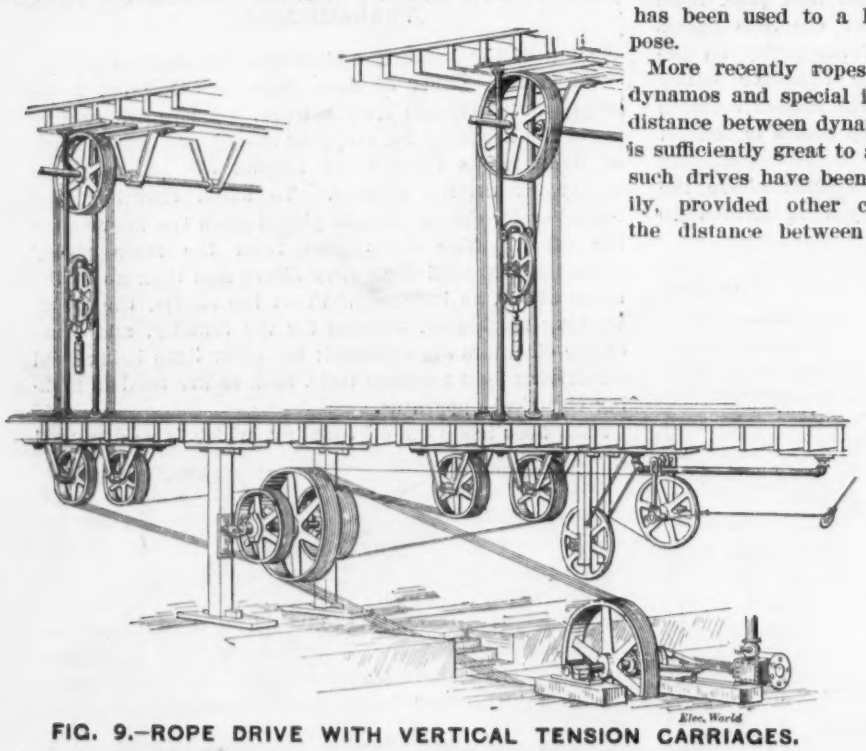


FIG. 9.—ROPE DRIVE WITH VERTICAL TENSION CARRIAGES.

power transmitted by a rope is proportional to the difference in stress in the driving and slack sides of the rope, the less weight on the tightener consistent with obtaining sufficient frictional resistance to slipping the better will the ropes work.

An example of rope driving, in which tension carriages are arranged to work vertically, is shown in Fig. 9. In this case the engine is 45 h. p. and runs at 90 revolutions per minute, corresponding to which the velocity of rope is about 1,700 feet per minute. The flywheel is six feet in diameter and is grooved for five 1¼-inch ropes. The main sheave on the jack shaft is also 6 feet in diameter and is grooved for five ropes. The rope passes continuously from the flywheel to the main sheave, making five wraps, then over the deflecting sheave to the horizontal tension carriage.

The jack shaft sheaves are grooved for four 1-inch ropes and are each provided with a friction clutch, giving the

* "Indian Engineering," 1888.

line two shafts and practically independent motors, so that in case of accident to either the other can be run independently.

The sheaves on these shafts are five feet in diameter and are grooved for five ropes; vertical tension carriages are used for the transmission to the line shafts.

Although used extensively for main drives and in many cases for intermediate driving, ropes have not come into use for general work throughout the factory. In certain cases the whole of the driving is done by ropes, no cross shafts, gears or belts being used; but the greater convenience of flat belts for conveying power to the machine in ordinary shop transmissions is so thoroughly acknowledged that any attempt to substitute rope for belting in general would be met with little favor; nor would this be practicable under the conditions which now obtain in our mills and factories.

One reason for this is the difficulty in shifting a rope from a tight to a loose pulley. Numerous devices have been employed for this purpose, but thus far with little success of adoption. Another reason for its non-employment for general work is the size of pulleys, which would exclude its use from many shops.

Where the power is transmitted to a shaft whose axis is in a different plane from that of the driver, it is often inconvenient or impracticable to use bevel gears or universal couplings. For such special cases rope driving is particularly satisfactory, as a flexible rope will readily conform to any direction and transmit its full power when arranged with suitable idlers.

An example of such transmission is given in Fig. 10. This drive transmits 150 h. p. for the main shaft at *a* to another at *b*, whose axis makes an acute angle with the first, and which is several feet lower. The drive sheave *a* is 5 feet 3 inches in diameter and runs at 160 revolutions per minute: it is grooved for six 1¼-inch ropes, which have a velocity of 2,800 feet per minute; *c* and *d* are idlers, the faces of which are nearly parallel to the drive sheave; *e* and *f* are double idlers, there being two sheaves on each shaft, one 1½ inches less in diameter than the other. This arrangement of idlers in quarter twist drives of this class has been introduced where there are more than four ropes in the system, with the object of reducing the wear consequent to the friction produced by the side lead of the rope. In drives where there are more than eight ropes, a cone has been used to a limited extent for the same purpose.

More recently ropes have been introduced to drive dynamos and special isolated machines, and where the distance between dynamos and engine, or driving shaft, is sufficiently great to allow a moderate sag in the ropes such drives have been found to work very satisfactorily, provided other conditions are favorable. Where the distance between shafts is limited, more wraps

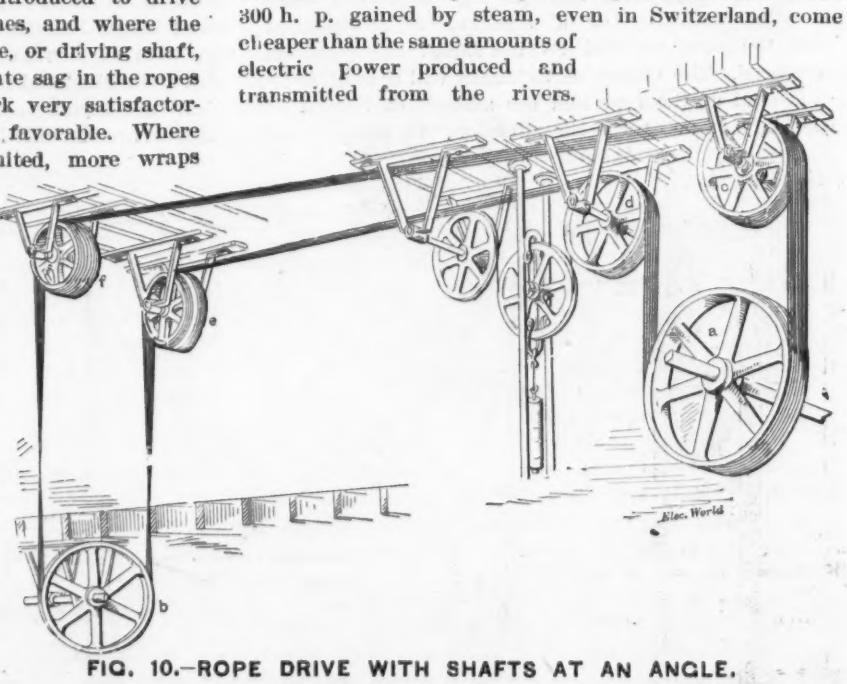


FIG. 10.—ROPE DRIVE WITH SHAFTS AT AN ANGLE.

should be given to the rope in order to lessen the tension in each member. One great fault with dynamo drives is the use of too small a pulley on the armature shaft. We can point to a score of plants using rope transmissions from a jack shaft to dynamo in which the rope is overstrained and the dynamo pulley is only half as large as it should be, in consequence of which the ropes are a constant source of trouble.

We have one case in mind where instead of a 30-inch pulley we find one in use only 10 inches in diameter for a three-quarter inch rope. If the jack shaft cannot be speeded up nor a larger driving pulley used in such a case as this it would be better to take out the rope and put in a good leather belt.

A Short Rule of Thumb.

A motor yielding a horse power for every kilowatt consumed has an efficiency of 75 per cent.—*Hering.*

Cost of Steam and Electrical Power.

The United States Consul at Chemnitz, Saxony, has sent an interesting report to the State Department, which we give below, containing some figures in regard to the cost in various parts of Europe of steam power and of electrical power in Switzerland. As no authority is given for the figures, nor the details upon which they are based, the great disparity shown should be viewed with some caution.

The Consul states that Saxony, of which Chemnitz is the most important manufacturing centre, is interested in the comparisons being made in Switzerland between steam power plants and electricity gained by utilizing water.

It used to be urged that Switzerland's water supply, if properly utilized for obtaining electricity, would reduce very considerably her cost of production. Not only has she many streams, but they fall from such heights that even rivers of small volume have great power. "Millions of horse power are going to waste in these hills," was a common expression. "Switzerland had only to make sluices, put in wheels, lay wires, and get for a 'song' what other less favored nations had to buy with enormous consumption of costly coal," was what even scientists said only a few years ago. The sluices were laid, dams made, wheels hung, and wires put down. What is the result? Every effort that science could suggest, ingenuity devise, or mechanics arrange was made in different cantons of the little Republic to gather electricity by, and transmit it from, her rivers and streams. The latest reports show that if Switzerland, or any other country with streams and climate like her's, is to win her way into the world's markets and take a place in the front ranks it must be by some better method than the use of electricity gained and transmitted from rivers and waterfalls.

The following table, just published in Chemnitz, shows what 50, 300 and 500 horse power costs in England, Germany, Bohemia and Switzerland per annum:

Country.	50 h. p.	300 h. p.	500 h. p.
England	$24.24	$12.58	$9.88
Germany	29.21	15.52	13.51
Bohemia	27.50	14.74	12.97
Switzerland	46.82	29.61	25.54

Compared with the above, the cost of the same amounts of horse power of electricity transmitted 3.1068 miles (5 kilometres) in an air line in Switzerland, according to results published in connection with the foregoing table, is as follows: 50 h. p., $30.88; 300 h. p., $16.98; 500 h. p., $12.54. But to this must be added the transmission cost, which will make the total as follows: 50 h. p., $57.68; 300 h.p., $31.27; 500 h. p., $25.48.

How, at these rates, is it possible to turn from steam to electricity? How is it possible for a people using so uncertain and expensive a power to compete with England, Bohemia, Belgium or Germany? It is only by building a big plant, 500 h. p. at the very least, that electricity begins to show any profit that would commend it as a substitute for steam. It is only then that its prices sink to those of the same amount of power yielded by its rival. The 50 and 300 h. p. gained by steam, even in Switzerland, come cheaper than the same amounts of electric power produced and transmitted from the rivers. These facts may be disappointing, but there they are—the results of experiments.

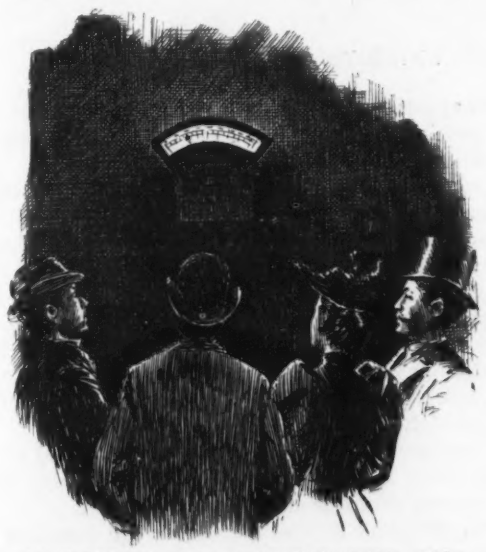
Switzerland, with its freshets, its uncertain supply of water (for, though there may always be enough, there may at times be too much), its icy winters, its electrical disturbances during mountain storms, and its dangers from high-strained currents, causing much inconvenience and labor in laying, caring for, and repairing the wires that carry the currents over long distances, is, after all, hardly the best place in the world for this experiment.

Add, then, to all these the necessity of keeping up a large reserve steam plant to carry on business when, from any of the causes cited, electricity fails. It is not claimed, however, that at all times and under all circumstances it will not pay to obtain power from streams and transmit it in the form of electricity. Where work is carried on day and night, in cases where the power is used also to supply light (which it does at very small cost), it can be made to take the place of coal at cheaper prices.

THAT the Weston instruments were adopted by unanimous consent of the jury as standards for all electrical measurements at the World's Fair, although gratifying to Mr. Weston and his past and present able assistants, was scarcely surprising, as the excellence of these instruments is recognized, both in this country and abroad. Prof. Ayrton, of England, who was himself identified with the manufacture of electrical measuring instruments for many years, made the proposition, although excellent instruments of English, German and French make, were at the disposal of the jury.

The exhibit of the Weston Electrical Instrument Company, in which one of each of the many different types and ranges of instruments manufactured by them is represented, affords the best illustration of the accuracy and care with which the manufacture of these instruments is carried out, even to the minutest details. This is especially true of the exhibit of sample boards containing all parts, down to the smallest screw, which enter into the construction of Weston instruments.

One of the accompanying illustrations shows a number of curious visitors deeply interested in one of the illuminated dial instruments; the brilliantly lighted



WATCHING THE ILLUMINATED DIAL.

scale stands out in bold relief from the dark background. This unique feature of the Weston station instruments has added to their popularity. A handsome collection of photographs of switchboards on which Weston station instruments are exclusively used decorates one of the walls of the booth at the rear of the exhibit and testifies to the immense popularity which these instruments have gained within less than one year. Although quite a number of these instruments are shown in operation at the exhibit of the company, their behavior under actual working conditions may be studied to better advantage on a number of switchboards in Electricity Building and Machinery Hall. In some cases they are in disguise, as, for instance, on a very handsome white marble board in Machinery Hall and on sundry small ones in Electricity Building, where the instrument is covered by a circular brass case with a plain white dial, in which an opening is made sufficiently large to show the illuminated dial. A full description of the Weston station instruments may be found in The Electrical World of March 18, 1893.

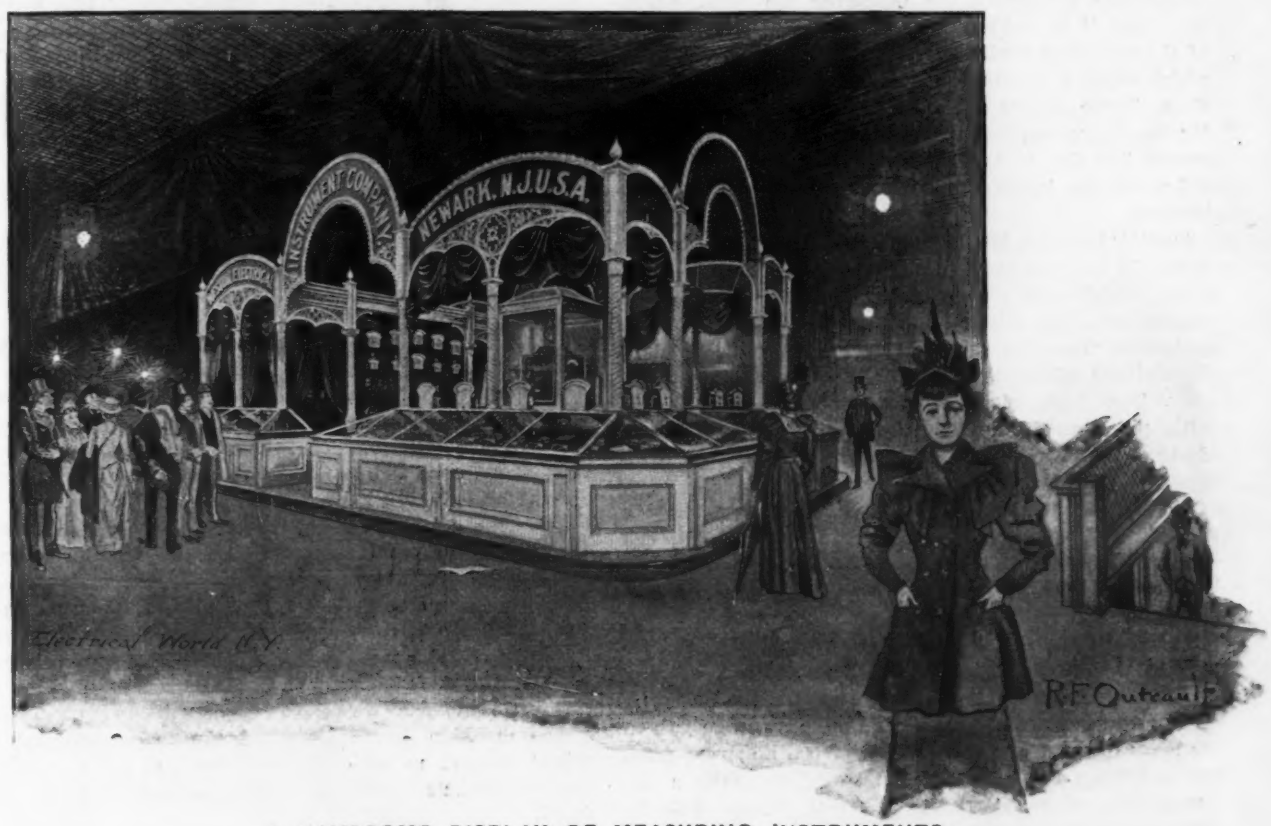
A very neat novelty in the portable instruments is shown in one of the accompanying illustrations. As will be seen, the instrument, a voltmeter, is placed in a mahogany box with lid and lock. A separate compartment is provided, in which are contained four "lamp adapters," one for each of the principal lamp sockets in use at the present time. The addition of this ingenious

A NOVEL TESTING SET.

device is apparently a great convenience to inspectors, since, in order to make suitable connections, it is only necessary to insert the respective adapter in place of a lamp and to make connection with the contact plug which fits all the different adapters.

The laboratory standard instruments were designed for the most rigid requirements of accuracy. The principle involved in their construction is the same as that used in the portable direct current instruments, only the dimensions of the apparatus are considerably increased, so that a scale 14 inches long is obtained. The scale itself is of peculiar construction. As will be seen from a portion of the scale here reproduced, a number of concentric circles divide the scale marks into five equal parts. A diagonal line is drawn from the top of one division mark to the bottom of the next one. This diagonal scale does away with all the guesswork of interpolation, since by means of the very narrow pointers the 1-10 part of one division can be read with accuracy by passing the eye along the index to a point where index and diagonal intersect each other. The variety of uses to which this type of instrument may be put is almost endless. With two such instruments, one with a high resistance coil for voltmeter purposes and one with the same of low resistance for current measurements by the fall of potential method, together with the necessary resistances and shunts, a most complete laboratory outfit can be obtained, and measurements can be made with an accuracy of 1-10 of one per cent. from a minute fraction of a volt or ampere up to several thousand. By means of Mr. Weston's special alloys without temperature coefficient a remarkably close compensation for temperature is obtained in these instruments, a result which has so far not been attained in any other type of instruments.

The direct reading wattmeter for alternating and direef current circuits involves essentially the same principle in its construction as that employed in the Weston portable voltmeter for alternating and direct current circuits, with this modification, that the main current passes through the stationary field coil of few turns of comparatively heavy copper wire, while the movable coil, in series with an appropriate amount of external resistance wound non-inductive, takes a very small portion of the main current, and is connected in



A HANDSOME DISPLAY OF MEASURING INSTRUMENTS.

SECTION OF A WESTON SCALE.

parallel with the object to be measured. Wattmeters are exhibited with ranges varying from 150 to 15,000 watts over the whole scale. The instrument illustrated is especially intended for the test of incandescent lamps,

DIRECT READING WATTMETER.

and has a range from 0 to 150 watts in single watt divisions. The maximum current capacity for this wattmeter is given as two amperes, and the maximum volt-

age allowable 150 volts. Electrically, these instruments are so dimensioned that errors due to self-induction are negligible.

The Weston ground detector, illustrated herewith, is shown in operation at the exhibit. It is really a modified voltmeter, and so constructed that it quickly indicates the existence of grounds, and also shows the insulation resistance of the circuit whenever consulted. It can, therefore, be trusted as a guide to determine whether the insulation of a circuit is deteriorating, and to indicate when the circuits need attention. In order to determine the actual insulation resistance of a circuit with this instrument, a simple calculation would be necessary; this calculation may be dispensed with, however, by means of a very ingenious and simple mechanical calculating device which is furnished with the instrument.

Ground Detector.

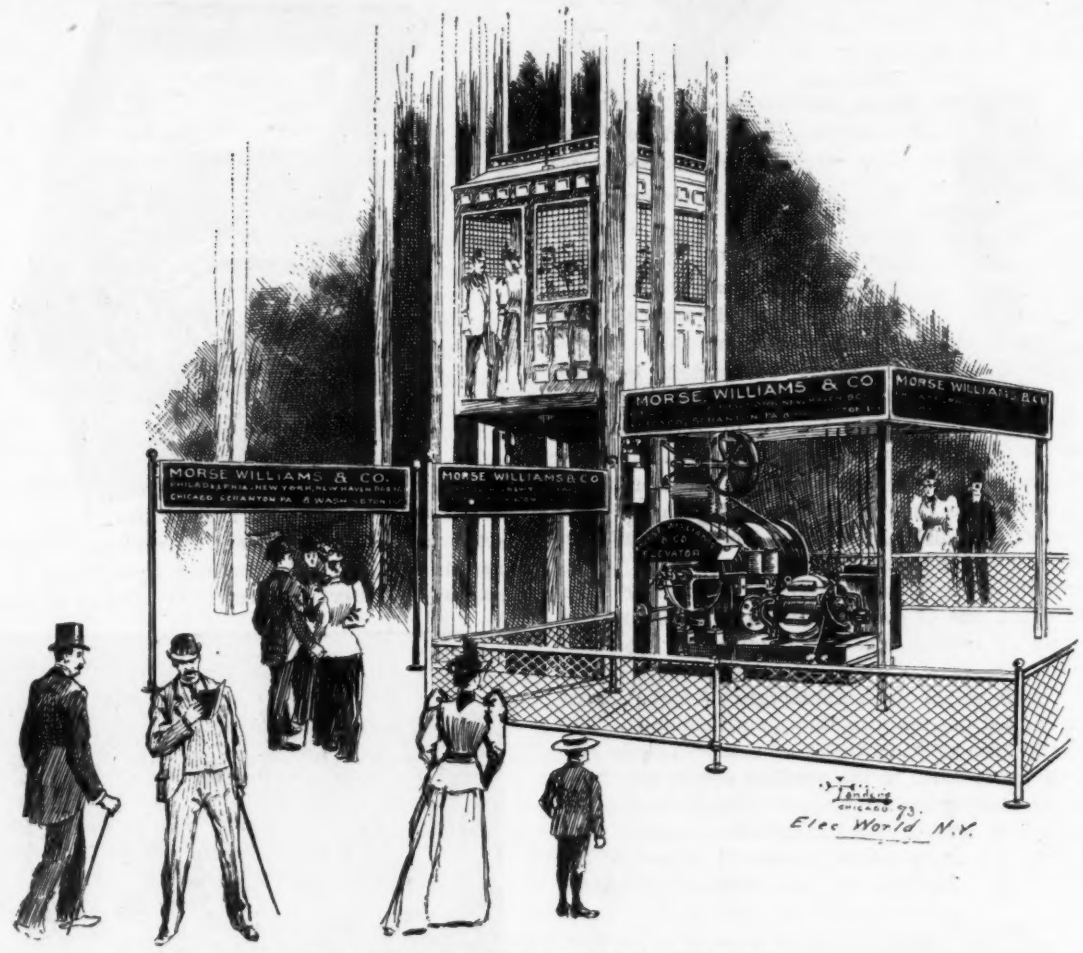
Alloys with negligible and negative temperature coefficients form probably one of the most extraordinary exhibits of its kind. When Mr. Weston gave to the world in 1885 for the first time the discovery that it was possible to make alloys which possess the above mentioned properties the fact was received with a good deal of incredulity. Since then the observations have been verified by other investigators here and abroad, and it has been found that the material possessing these remarkable properties has moreover the great advantage that it is, with proper treatment, absolutely free of the annoying qualities of german silver and platinoid which cause a continual change of their resistance with time. These alloys are used by the company not only for the compensation for temperature of their instruments, but also in their portable and laboratory standard resistance boxes, of which a complete set is on exhibition.

Another result of Mr. Weston's inventive genius is to be found in his standard cell without temperature coefficient, which also is on exhibition. The general arrangement of the cell and the ingredients used in it may be known from the patent specifications and the short descriptions which appeared in the beginning of this year. The form adopted is the well known H form, with platinum leading-in wires at the bottom. One electrode is formed of mercury or amalgamated platinum, covered by mercurous sulphate paste. The other of cadmium amalgam; the liquid filling the cell is a concentrated solution of cadmium sulphate. The cell has an E. M. F. of 1.019 volts, and possesses the extraordinary quality that its E. M. F. is practically constant for changes in temperature. The safe limit of temperature given is from 5 degrees to 60 degrees centigrade, within which limit the E. M. F. of the cell may be considered absolutely constant even for the most rigorous requirements of accuracy. The advantage gained for accurate measurements will be more apparent from the following consideration: In order to make a determination with a Carhart-Clark cell, which is to be accurate to 0.01 per cent., the temperature of the cell has to be determined accurately within ¼ of a degree centigrade and the cell must be kept at a definite temperature within this limit for a considerable time, since its temperature coefficient is only correct under the supposition that all parts of the cell have the same temperature. The Clark standard is therefore really only a secondary standard, the accuracy attainable with it depending primarily upon the accuracy with which the temperature determination can be made. The Weston standard is, however, by reason of its independence of temperature measurements, a primary standard, the accuracy attainable depending simply upon the accuracy with which its electromotive force has been determined.

The two last named inventions of Mr. Weston, and of which the Weston Instrument Company is the beneficiary, are probably two of the most important and most valuable contributions to the art of electrical measurements that have been recently made.

Display of Morse, Williams & Co.

An exhibit which not only attracted the attention of the sightseer, but ministered to his comfort as well, was that of Morse, Williams & Co., of Philadelphia, Pa., a view of which is shown in the accompanying illustration. This elevator conveyed passengers from the floor of the Transportation Building to the gallery, and an excellent opportunity was given of testing the machine under the exacting conditions of daily practice. So satisfactory and efficient was its operation that as a result the demand has increased for this already well known elevator.



ONE OF THE MOST USEFUL EXHIBITS.

The field of the electric elevator has broadened during the past few years until now this form of machine is very popular, especially for passenger work, where simplicity of construction, accessibility of parts and smoothness of running are particularly desirable. The Morse, Williams & Co.'s elevator was designed especially with a view of obtaining these features, and the success with which it has met is evidence that the desired results were obtained.

The machine has a worm of bronze or steel and a wheel incased in an oil-tight housing; the thrust of the worm-shaft is taken on hard metal buttons revolving in oil.

The motor is attached to the wormshaft by means of a coupling. The wormshaft is provided with a powerful double shoe brake, which is released by the action of an electromagnet and is applied by a weight. The special advantage of this arrangement is shown in case the electric current from any cause be cut off, as the brake would be instantly applied, thus stopping the machine. The brake is so constructed as to act as a governor in checking the descent of the car, should it be accelerated beyond the normal speed at which the motor is designed to run it.

The drum upon which the cables wind is grooved in the lathe, and keyed fast to the heavy shaft, to which the worm-wheel is also keyed. This shaft is provided with stop collars and nuts, arranged to stop the car at terminal landings independent of the operator.

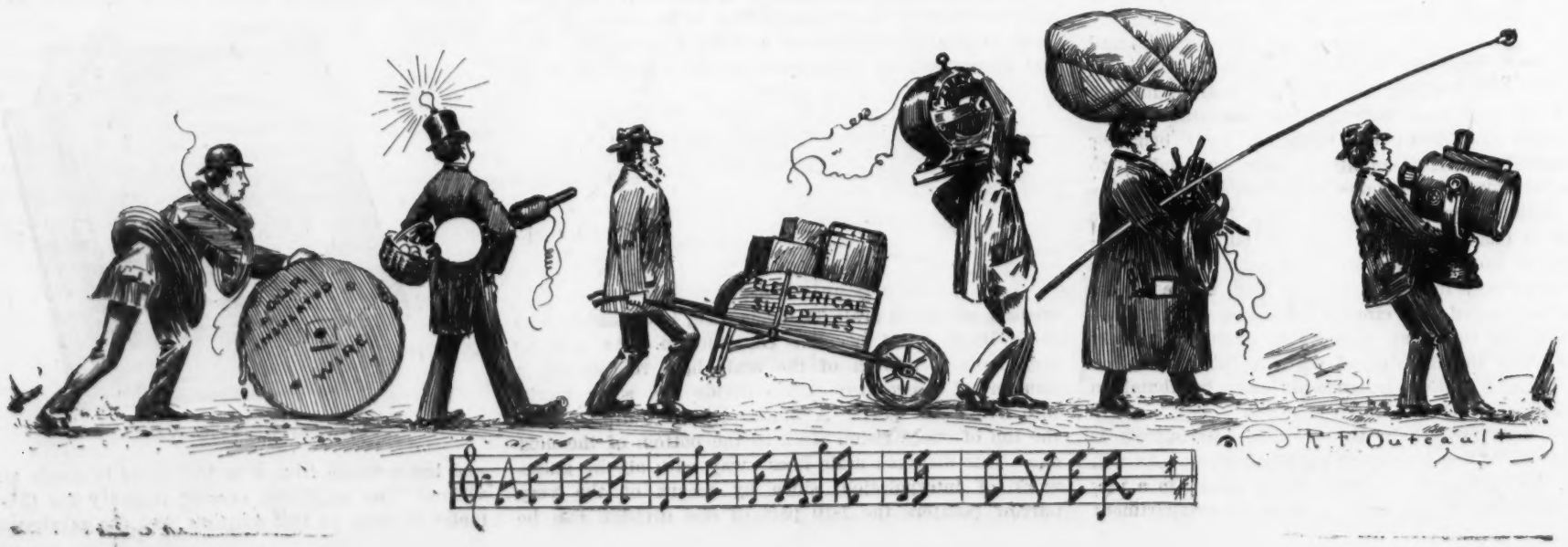
The slack cable stop arrangement is also a feature of this machine; it stops the machine automatically in case the car should become obstructed in its descent and stop. Without such an attachment there would be an unwinding and consequent entanglement of the cables with the machinery.

The motor is of the slow speed, multipolar type; the bearings are self-oiling; carbon brushes are used, requiring a minimum of attention. The reversing switches and controlling apparatus are of simple and improved forms, their action causing the elevator to start easily and gently with and without a load.

The whole apparatus is placed on a heavy cast iron bed plate, and the motor is thoroughly insulated therefrom when a high-tension current is used, to obviate danger of shock in the car. The efficiency of the machines has been tested under varying conditions, and the makers claim that the average amount of current consumed, both in raising the load and lowering the empty car, has been found to be lower than in any other type of direct electric elevator These machines are designed to raise average loads at speeds as high as 250 feet per minute.

The passenger cars are carefully constructed of seasoned lumber, well ironed and braced and equipped with the most reliable safety devices.

Morse, Williams & Co. manufacture a complete line of passenger and freight elevators and have unsurpassed shop facilities for this class of work. They received the highest award at the World's Fair for the direct electric elevator described above.



On the Current Strengths in Simple Circuits Containing Resistance, Inductance and Capacity Under Periodic Impressed Electromotive Forces of the Rectangular Wave Type.

BY A. E. KENNELLY.

In THE ELECTRICAL WORLD for March 18, 1893, Vol. XXI., No. 11, p. 203, a formula is given for determining the effective alternating current strength in a simple circuit containing resistance and inductance when the E. M. F. acting upon it is periodically reversed by a perfectly adjusted pole changer.

That formula may be written

$$I = \frac{E}{R}\sqrt{\frac{\tanh\frac{x}{2}}{1-\frac{x}{2}}}, \qquad (1)$$

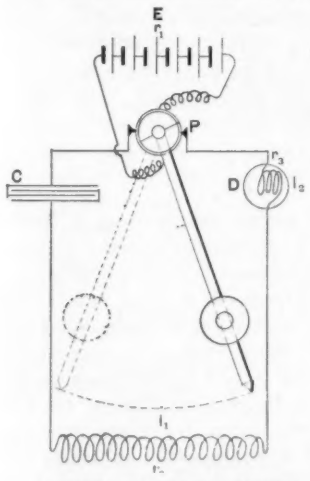
where $x = \theta/\tau$, the ratio of the semi-period to the time constant of the circuit.

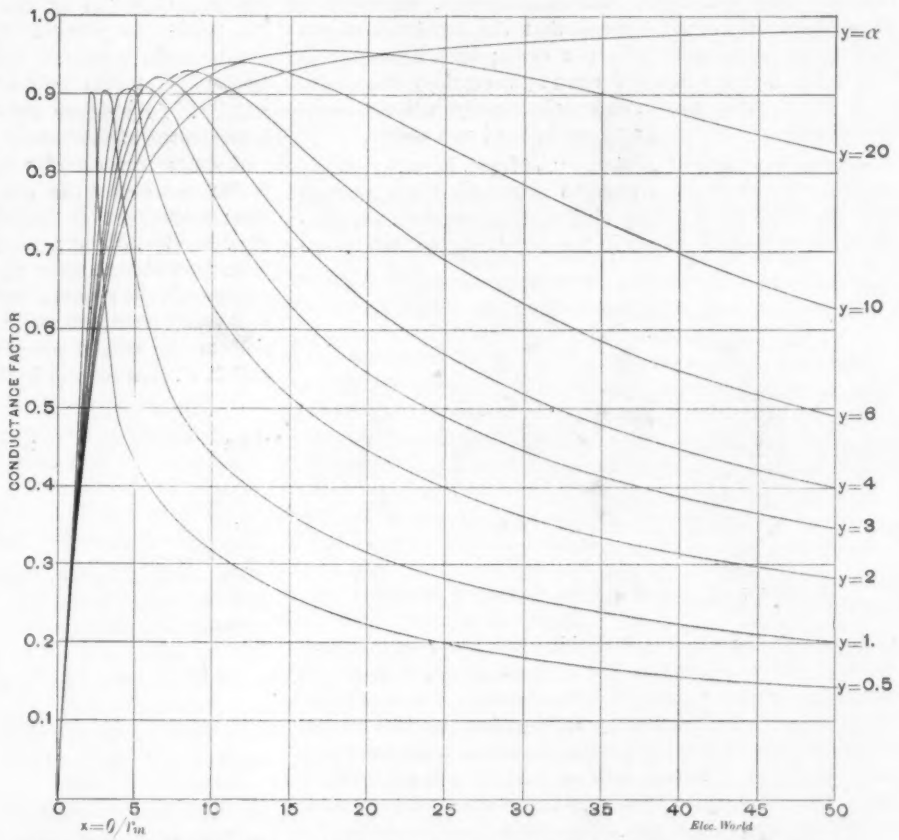
In THE ELECTRICAL WORLD for April 8, 1893, Vol. XXI., No.14, p 261, the corresponding formula is stated for the case of a simple circuit containing capacity and resistance, viz.:

$$I = \frac{E}{R}\sqrt{\frac{\tanh\frac{x}{2}}{\frac{x}{2}}}, \qquad (2)$$

x being again the ratio of the semi-period to the electrostatic time constant $C\,R$.

The case of a simple circuit containing resistance non-ferric inductance and capacity in series, may here be considered as represented in Fig. 1. The reversals are effected by the perfectly adjusted pole changer attached to the pendulum. Such a circuit will have a total resistance of R ohms, a total capacity of C farads and a total inductance of L henrys. It will therefore possess an electrostatic time constant $\tau_s = C\,R$ seconds, and an electro-magnetic time constant $\tau_m = L/R$ seconds. Let the numerical ratio of these two time constants $\tau_s/\tau_m = C\,R^2/L$ be denoted by y





FIGS. 1 AND 2.—SIMPLE CIRCUITS CONTAINING RESISTANCE, INDUCTANCE AND CAPACITY.

and let $x = \theta/\tau_m$, where θ is the duration of the semi-period or the time occupied by one reversal. Then after the pole changer has become steadily active, the effective current strength in the circuit will be

$$I = \frac{E}{R}\sqrt{\frac{1}{J}\left(\frac{\tanh\xi}{\xi} - \frac{\tanh\eta}{\eta}\right)}, \qquad (3)$$

where $J = \sqrt{1-\frac{4}{y}}$,

$$\xi = \frac{x}{4}\left(1-\sqrt{1-\frac{4}{y}}\right)$$

and $$\eta = \frac{x}{4}\left(1+\sqrt{1-\frac{4}{y}}\right).$$

The coefficient of E/R may be called the conductance factor of the circuit, and its reciprocal the impedance factor.

When y is not greater than 4 this formula becomes arithmetically unmanageable, but can be transformed as follows:

$$\text{When } y = 4,\ I = \frac{E}{R}\sqrt{2\left(\frac{\tanh\frac{x}{4}}{\frac{x}{4}} - \operatorname{sech}^2\frac{x}{4}\right)}; \qquad (4)$$

$$\text{when } y < 4,\ I = \frac{E}{R}\sqrt{\frac{2y}{\beta x}\left(\frac{\beta\sinh\frac{x}{2} - \sin\frac{\beta x}{2}}{\cosh\frac{x}{2} + \cos\frac{\beta x}{2}}\right)}, \qquad (5)$$

where $\beta = \sqrt{\frac{4}{y}-1}$.

If $y = \infty$, which would correspond to the case of an infinitely great capacity—that is, to a short-circuited condenser—(3) becomes $I = \frac{E}{R}\sqrt{\frac{\tanh\frac{x}{2}}{\frac{x}{2}}}$, coinciding with (2).

From these formulas the following table has been prepared:

TABLE OF CONDUCTANCE FACTORS FOR NINE FIXED VALUES OF y AND FIFTEEN VALUES OF x.

x	$y=0.5$	$y=1$	$y=2$	$y=3$	$y=4$	$y=6$	$y=10$	$y=20$	$y=\infty$
1	0.3357	0.3027	0.2884	0.2832	0.28165	0.2772	0.2767	0.2763	0.2753
2	0.8661	0.6620	0.5660	0.5378	0.5250	0.5118	0.5025	0.4951	0.4883
3	0.6921	0.9033	0.7892	0.7344	0.6618	0.6807	0.6528	0.6445	0.6297
4	0.4783	0.8230	0.9013	0.8578	0.8466	0.7922	0.7633	0.7418	0.7197
5	0.4090	0.6888	0.9047	0.9115	0.8924	0.8614	0.8311	0.8050	0.7782
6	0.4011	0.6046	0.8165	0.9157	0.9194	0.8923	0.8738	0.8476	0.8177
8	0.3585	0.4897	0.7071	0.8559	0.9070	0.9295	0.9204	0.8981	0.8658
10	0.3141	0.4482	0.6325	0.7774	0.8580	0.9200	0.9374	0.9255	0.8944
12	0.2886	0.4083	0.5773	0.7071	0.8043	0.8942	0.9393	0.9413	0.9129
16	0.2500	0.3537	0.500	0.6124	0.7071	0.8263	0.9193	0.9532	0.9354
20	0.2236	0.3163	0.4472	0.5477	0.6325	0.7591	0.8846	0.9522	0.9488
24	0.2041	0.2888	0.4083	0.5001	0.5773	0.7011	0.8450	0.9439	0.9579
32	0.1768	0.2500	0.3536	0.4330	0.500	0.6113	0.7634	0.9152	0.9682
40	0.1581	0.2236	0.3163	0.3873	0.4472	0.5475	0.6983	0.8783	0.9747
50	0.1415	0.2000	0.2828	0.3464	0.40	0.4899	0.6268	0.8280	0.9794

From this table the curves in Fig. 2 have been drawn.

If it were possible to completely remove inductance and capacity from such a circuit, its current strength would be regulated only by the resistance, and would remain at the value E/R, whether the pole changer vibrated or not. The insertion of non-ferric inductance, such as a galvanometer coil into the circuit, would increase the impedance and introduce a conductance factor. We know that if the alternating E. M. F. were sinusoidal, it would be possible for a given frequency and inductance, to insert in the circuit a condenser of such capacity as would neutralize the impeding effect of the inductance and restore the current strength to E/R ampères, with the conductance factor to unity. The curves of Fig. 2 show, however, that when the alternating E. M. F. is rectangular instead of sinusoidal, no condenser can completely neutralize the influence of the inductance, but partial compensation can always be effected by a judicious selection of capacity. If the frequency be less than that required to make $x = 2$, the conductance factor can always be made more than 0.9. For example, if $x = 2.2$ so that the semi-period is $2.2 \times$ the electromagnetic time constant, the conductance factor without capacity would be 0.52. The insertion of a condenser of such capacity as would make $y = 0.5$ is shown in Fig. 2 to raise the conductance factor to 0.9, and this would be the maximum possible at that frequency for any capacity.

With higher frequencies, namely such as make the semi-period considerably less than half the magnetic time constant, the insertion of a gradually increasing capacity into the circuit no longer produces a steady increase of current strength to a single maximum followed by a decline. There will be fluctuations in the current strength, so that a slight increase of capacity may diminish the current, while a further slight addition may raise it, and a still further increase of capacity may reduce the conductance factor again. In fact if the curves of Fig. 2 were drawn for diminishing values of y below 0.5 the ascent and descent near the maximum would exhibit abrupt undulations, always attended, however, with a diminishing maximum conductance factor.

As an example of the application of these principles, consider the case of a circuit whose resistance is 100 ohms and inductance 0.1 henry, operated under an E.M.F. of 2 volts, making 200 reversals per second. If there were no inductance the current strength would be 2/100 ampère. The inductance will reduce the current. The time-constant of the circuit being $0.1/100 = 0.001$ second, and the semi-period being 1/200 second, the ratio $\theta/\tau = x = 5$, and by formula (1) the conductance factor becomes 0.782, bringing the current to 15.64 milliampères. If a capacity of, say, 10 microfarads (0.00001 farad) be inserted in the circuit, the effect upon the current may be determined by formula (5), for the static time-constant CR is $0.00001 \times 100 = 0.001$ second, making the ratio $y = 1$. The conductance factor for $x = 5$ and $y = 1$ is shown by the curves and table to be 0.6888, so that the current is reduced to 13.776 milliampères. The capacity which will make the current strength a maximum is shown by Fig. 2 to be approximately represented by $y = 3$, making the conductance factor 0.912, the current 18.24 milliampères, and the condenser required 30 microfarads.

If, instead of periodically reversing an E. M. F. upon a circuit, the E. M. F. is simply introduced and removed at equal successive intervals, it is evident that all the preceding formulas will apply, except that the value of the E. M. F. must be halved, since the current established by five volts alternately applied to a circuit will be the same as that from ten volts applied in one direction for half the time. It is necessary to assume, however, that on withdrawing the E. M. F. there is no opening of the circuit, or at least that the process of removal occupies a negligibly brief interval, while any resistance resident in the source of E. M. F., such as the internal resistance of a battery, must be substituted in the circuit during the periods of removal.

Electromotive forces of the rectangular wave type, while of considerably less importance than those of sinusoidal type, are yet not without practical applications. The current strengths they establish seem to have been hitherto algebraically determined solely by the use of infinite convergent series. For simple series circuits they are here seen to be capable of complete expression in brief and simple formulas.

Blackening of Incandescent Lamp Bulbs.

BY W. STUART-SMITH.

In looking over the issues of an electrical journal for this year I have repeatedly noticed discussions as to the cause of blackening of incandescent lamp bulbs. The latest theory seems to come from France, and is to the effect that residual oxygen in the bulb, together with that which was occluded in the filament, attacks the carbon and forms carbonic oxide, which undergoes dissociation by coming in contact with the comparatively cold glass, depositing the carbon and leaving the oxygen free for a repetition of the process. It has been some years since I have paid attention to chemical matters, but, unless I am mistaken, cooling as above would *not* cause dissociation, and the above explanation cannot be the correct one. It seems to me that a portion of the action, at least, *must* be due to the following cause: It is well known that all substances in the solid or liquid form give off vapor, in fact, are surrounded by an atmosphere of their own vapor. If the substance is confined in an airtight space the vapor density is definite for every substance and for every temperature, but varies greatly with the temperature, being much greater for high temperatures.

For a given substance and a given temperature the vapor density will be the same no matter what other gases may be present, but if other gases are present in considerable quantities considerably more time will be required for the density to reach its maximum value. In a vacuum, on the contrary, the action is comparatively rapid.

Carbon when cold is a very stable substance and its vapor density very low, but at the high temperature of the white-hot filament vaporization must be comparatively rapid and the vapor density relatively great. As the hot vapor comes in contact with the cooler glass it will deposit, and thus vaporization, instead of stopping as would be the case if the glass was the same temperature as the filament, continues while the lamp is burning. When the lamp is extinguished the vapor in the globe must deposit on the glass until the definite density of the vapor of the cold carbon is attained. The more rapid blackening when the lamp is new may be due in part to the better condensing action of the clean glass, and it may be due in a greater part to the fact that some portions of the filament are more easily volatilized than others and the action consequently more rapid while these are being thrown off.

Incandescent Lamp Experiments.

A recent issue of the London "Electrician" states that some curious experiments upon incandescent lamps have been described by Mr. A. A. C. Swinton. By means of a high-frequency alternator, and a condenser formed out of a thick plate of glass and a couple of wire ends, it was possible to raise an ordinary 100-volt incandescent lamp to full incandescence. The explanation which Mr. Swinton offers is that the current consists of very brief intervals of enormous current alternating with longer intervals of practically no current. He observes that with a steady pressure of 100 volts the 5-c. p. lamp would expend 25 joules in every second, at a steady rate of 25 watts. With a high-frequency current of 100,000 ~ per second, and 10,000 volts, it is clear that each pulsation would be required to produce 0.00025 joule, and to pass only 0.000000025 coulomb, in order to develop the same energy per second. The average current in the lamp during any one impulse would be as great as 25 ampères; but each impulse would be followed by a period of inactivity 999 times as long, making the average current in the complete second only 0.0025 ampère. The thermal capacity of the filament would prevent its temperature varying in the same ratio as the extremely variable power, and would cause it to emit a practically steady light. In the same way, for example, we might apply a transient force of many millions of pounds to the rim of a flywheel, while causing it to turn only with the normal speed which a steady force of 100 pounds would produce.

THE ELECTRICAL WORLD'S DIGEST

OF

CURRENT TECHNICAL ELECTRICAL LITERATURE.

(Compiled from the principal foreign electrical journals.)

BY CARL HERING.

ELECTRO PHYSICS.

High Frequency Currents.—The Lond. "Elec.," Oct. 20, in an editorial, calls attention to some recent experiments by Mr. Swinton; an ordinary 100-volt lamp was raised to full incandescence by a high frequency alternator and a condenser made of a thick plate of glass and a couple of wire ends. (See Digest Oct. 21.) The explanation which he offers is that the current consists of brief intervals of enormous current alternating with long intervals of practically no current. With a steady pressure of 100 volts a 5 c. p. lamp would require 25 joules in every second at a steady rate of 25 watts; with a current of 100,000 periods per second and 10,000 volts each pulsation must produce 0.00025 joule and pass only 0.000000025 coulomb in order to develop the same energy per second. The average current during one impulse would be as great as 25 ampères, but each impulse would be followed by a period of inactivity 999 times as long, making the average current in a second only 0.0025 ampère. His previous explanation was that the inductance of the current elements of the filament on one another was so enormous that the current flows entirely through the outside skin or layer of the conductor. Mr. Rimington showed by calculation that to produce this effect the frequency would have to be enormous; if there is no skin effect it is difficult to see how 25 ampères can be passed through the human body, although it is said that a very much greater number of ampères is produced in Leyden jar discharges which are not injurious. The editorial adds that it seems probable that the true explanation is a combination of the two hypotheses.

Sparking Distances in Paraffin.—The Lond. "Elec.," Oct. 20, abstracts an article by Dr. Monti from "L'Elettricista" for October, describing briefly his experiments; the paraffin used liquefied at 54.76 degrees C., and the terminals were made of brass balls; after being melted the paraffin was allowed to solidify in a partial vacuum of 100 millimetres, and was then fused again and allowed to solidify in air, the object of which was to avoid air bubbles between the terminals. In the test he compared paraffin with air; the results show that to discharge through a layer of paraffin 1 millimetre thick, between knobs 5 millimetres in diameter, requires a difference of potential of 155,000 volts; according to Freyberg the corresponding difference of potential for air under the same circumstances is 5,050 volts. Dr. Macfarlane had found that for a thickness of 3 millimetres, a difference of potential of 39,000 volts was sufficient, which is far below the values of Steinmetz and Monti; this difference Monti believes to be due to the presence of air bubbles in the paraffin in Macfarlane's tests.

Piezo Electric Quality of Quartz.—The Lond. "Elec.," Oct. 20, reprints an article by Lord Kelvin intended as an addendum to his paper mentioned in the Digest, Oct. 14; in it he offers an explanation of the phenomenon. An editorial notice in that journal says that in the dielectric crystal all that is necessary is a certain space variation of stress, but Prof. Fitzgerald has pointed out that this is not sufficient to produce the effect in a system of dissimilar conductors, as these will require both a space variation and a time variation; it states also that the analogue of a thermopile can be constructed with differences in the time rate of variation of the pressures at the junctions.

Propagation of Light in Metals.—Mr. Raveau's serial on this subject is continued in "La Lum. Elec.," Oct. 21.

Electro-magnetic Theory.—Mr. Heaviside's long serial in the Lond. "Elec." is continued in the issue of Oct. 20.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Eclair Meter.—In "L'Elec.," Oct. 14, Mr. Rechniewski gives a well illustrated description of the improved form of this meter which in its original form was brought out several years ago. The current is measured by an electro-dynamic balance, the attraction in which is measured by a spiral spring operated by a small and very ingenious constant speed motor which increases the tension of the spring until it balances the electro-dynamic attraction; the measurements are integrated periodically by recording the angle through which the spiral spring must be turned; it is applicable to alternating as well as to direct currents: one of the interesting features is that the constant loss in the motor and fine wire circuit is only four to five watts, while that in the series coil of the balance is for the greatest current only 0.3 volt; no fraudulent interference, by means of magnets or otherwise, is possible: a curve of a test made in Paris is given, which shows that in a meter for 100 volts and 15 ampères the errors were less than one per cent.

Borcherding Meter.—"La Lum. Elec.," Oct. 21, illustrates and describes briefly this meter, the underlying principle of which is that an iron core forming the end of a pendulum is sucked into a coil carried at the end of the pendulum, the core being supported on a spring; the length of the pendulum is thereby increased as the current becomes greater; the current is led to the moving coil by means of mercury cups.

DYNAMOS AND MOTORS.

Labour Alternator.—In "La Lum. Elec.," Oct. 21, Mr. Guilbert describes at some length a new alternator made by a French company; it is intended more especially to replace the de Meritens magnetos which were heretofore used almost exclusively for lighthouse lighting; one of these machines was made for the French government for that purpose, and of this a number of curves and tables of data are given; it is intended for low tension currents, and may be either self or separately excited, one of the most important features being that the curve of the current is more regular and more nearly a sine curve than in the usual forms. The self-exciting form is based on the principle that if two wires be connected to two diametrically opposite points on the Gramme ring winding of a bi-polar continuous current machine, and led to two contact rings, an alternating current will be obtained from them, while at the same time the continuous current from the commutator may be used for excitation; he shows how this same principle is applied to multipolar alternators, in which therefore the armature coils are in multiple. An important point in the design is that the poles of the field magnets are so enlarged as to almost meet, the space between them at the circumference of the armature being at most equal to double the air space between the poles and the armature iron; this forms a regularly increasing and decreasing field, and leaves no part of the armature winding in a neutral field; in the usual form of alternators there is quite a space between the successive field poles, and the wires around these parts are moving in a neutral field; the armature has teeth and the winding on its surface is wound like a rectangular spiral coil, but it may also be wound as a simple Gramme ring winding; various diagrams, curves and illustrations are given; it seems that the efficiency is not very good, being only 72.2 per cent; such a machine is said to be better adapted for arc lighting than others are, it is more stable when run synchronously, will run absolutely without humming and can be used as a motor.

Alternating Current Motor.—"La Lum. Elec.," Oct. 21, describes an alternating current motor having a rotating field produced by a simple single-phase current; the general arrangement is shown in the adjoining cut which explains itself; the winding is divided into three equal parts, through one of which the line current flows, through another the current is obtained from a transformer as shown, which lags behind the first by 120 degrees, and the third is a combination of these two currents; this arrangement produces the same rotating field as that of a regular three-phase current; instead of using a transformer for producing a lighting current, a self induction coil, or condenser, or both, can be used; similarly a winding may be made giving a number of poles; (the description does not state whether such motors have been constructed, and it may have been taken merely from a patent specification; the idea of producing a rotating field in this way is not quite new).

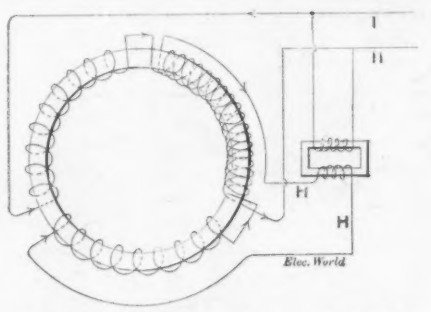
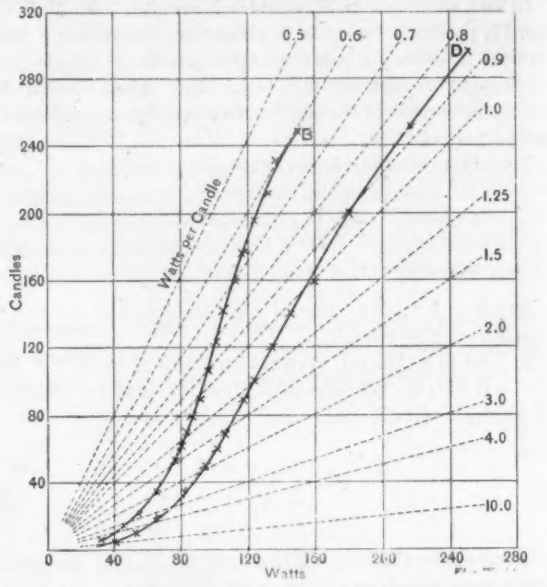


Diagram of Alternating Current Motor.

Non-synchronous Motors.—"La Lum. Elec.," Oct. 21, contains a mathematical article by Messrs. A. and J. Boissonas, in which they give a method of calculation applicable to all non-synchronous motors, for determining the work and efficiency. Several curves are given which are of interest; among other conclusions they state that the electrical efficiency is independent of the current in the field and of the voltage at the terminals, it depends only on the relative velocities of the armature and the field; when the current is constant the self-regulation is nearly perfect, and the maximum efficiency coincides almost exactly with the point of maximum output, which is not the case when run at constant potential; curves are given showing this; when at rest and at constant potential the current attains such a value as to absorb up to 7½ times the maximum useful work, and therefore it is very important not to short-circuit the windings of the armature until after the motor is started, as otherwise the motor will not run economically, and cannot be used with currents intended for lighting also.

ARC AND INCANDESCENT LIGHTS.

Relation Between Light and Power.—In the concluding portion of Mr. Ram's serial on incandescent lamp manufacture in the Lond. "Elec.," Oct. 20, he discusses the subject of the relation of the light given to the power consumed; he mentions that Prof. Jamieson found the candle power to be approximately proportional to the sixth power of the voltage, and therefore to the sixth power of the current as the resistance of the filament when incandescent does not alter very much; he also mentions the tests of Prof. Ayrton, published in part in that journal July 15, 1892, which show that there is a definite relation between the logarithms of the candle power and of the volts, ampères or watts. Mr. Ram gives a table of results and a number of curves of tests made by himself, which were carried to a much higher temperature than those of Prof. Ayrton; they were made with Edison-Swan lamps, and were carried up to the breaking point; the results are shown in the accompanying diagram, in which the dotted



Relation Between Watts and Candle Power.

lines represent watts per candle; both curves turn over at their upper ends, which is caused by the disintegration of the filament and the breaking of the bulb; the results for these points depend very much on the quickness with which the test is made, for if kept long at this temperature the filaments deteriorate rapidly. In another set of curves he shows the relation between the logarithms of the candle power and the volts and watts respectively; up to the point where rapid deterioration begins the observations lie nearly in a straight line; assuming that they should do so the formula becomes $c.\ p. = aV^n$, a and n being constants, to find which at least two observations must be made, but they must be made with the greatest care and as wide apart as possible, as a small error will make a great difference. If $c.\ p.$ represents the candle power at the lower reading for v volts, and $C.\ P.$ that for the higher reading at V volts,

$$\text{then} \qquad n = \frac{\log \frac{C.\ P.}{c.\ p.}}{\log \frac{V}{v}}$$

$$\text{and} \qquad a = \frac{c.\ p.}{v^n} = \frac{C.\ P.}{V^n}.$$

For lamp B in the above curves the readings at 30 and 55 volts were 6.2 and 158 c. p. respectively, and the values of n and a were found to be 5.35 and 7.76×10^{-8}; for lamp D at 39 volts, 10 c. p., and 57 volts 80 c. p., $n = 5.51$ and $a = 1.695 \times 10^{-8}$. He gives curves for the calculated and the observed values which show very good agreement; they begin to diverge above 180 c. p. for B representing an efficiency of 0.65 watt per candle, and at 100 c. p. for D at 1.25 watts per candle. In conclusion he states that it is probable that the relation of candle powers to watts is a more constant one among different lamps than that of the candle power to volts or ampères, the constancy of the resistance having an effect in the latter case but not in the former; (if this is not the case, it is to be regretted that he did not give the formula and constants for watts instead of volts).

Lighthouse Lights.—The article of Mr. Bochet on electric lighthouses is concluded in "L'Elec.," Oct. 14. To show the effect of the atmosphere he gives a short table of the distances (presumably the distance at which the lights can still be seen plainly) for different candle powers and different states of the atmosphere; for 800,000 candles the distance is 204 kilometers for clear weather, 85 for medium weather, and 31.5 for foggy atmosphere; for 10,000,000 candles the figures are 260 and 105, and 42.5 respectively, all referring to the ocean, as the corresponding figures for the Mediterranean are greater, except for clear air. He then describes the light at La Hève, which is said to be the brightest lighthouse in the world; (see also Digest Oct. 28). It is a periodic light, flashing every 5 seconds; instead of 8 to 16 panels of lenses, they have been reduced in this one to 4; these revolve once in every 20 seconds, the weight being supported by floating them in a bath of mercury. He gives the following figures for various lights used at that place: Oil lamps with reflectors, 800 carcels, seen in clear weather at 41 nautical miles; oil lamps with fixed lenses, 2,000 carcels and 49.5 miles; electric arc with fixed lenses, 4,500 carcels, and 57.5 miles; lights with flashing lenses, 2,500,000 carcels and 130.6 miles. He gives the following formula for calculating the distance to which the light carries when limited by the curvature of the earth, $d = \sqrt{\frac{r\,h}{0.42}}$, in which r is the radius of the curvature of the earth, $r = 6{,}366{,}953$, and h is the height, presumably in meters; at La Hève the geographical limit is 23 miles, the light therefore carries further than the geographical limit, the object of this increase being to compensate for the absorption in a fog. In conclusion he says that all the improvements were made by Frenchmen, who lead the world in such apparatus.

Further information regarding the new lighthouse at La Hève, is given at some length by Mr. Audra in the "Bul. Soc. Belge," for May, just issued.

Arc Light Carbons.—The "Electro Techniker," Oct. 15, describes an improvement used by the firm of Krupp in Essen, which consists in saturating the carbon, or mixing the carbon paste from which they are made, with tungstic acid, or tungstates; this increases the number of hours during which the carbon will last in the ratio of 18 to 21, or by using a slightly larger lower carbon the time may be increased 28 per cent.; the light giving property is also increased, and the carbon dust which usually forms in a burning lamp and represents a waste of carbon, is thereby prevented.

Lamp Holders.—The Lond. "Elec.," Oct. 20, continues its illustrated serial on this subject.

TRANSMISSION OF POWER.

Transmission of Power for Mines.—In an article under this heading, Mr. Haubtmann, in "L'Elec.," Oct. 14, speaks of the importance and the success of electrical transmission in a number of mines in Central and South America, in which he says the Pelton waterwheel, the Thomson-Houston and the Gramme machines at 1,500 to 2,090 volts are used most frequently. He describes the plant at Faria, Brazil, which has been running for over three years; 20 h. p. are transmitted for a distance of over a mile, at about 300 volts, with two separate machines and two separate circuits at an efficiency of from 50 to 55 per cent.; the apparatus was installed entirely by French manufacturers; (we venture to say it would have been done differently if it had been done by American firms.)

Three-Phase Transmission from Boujean to Bienne.—"Rev. de L'Elec.," for Sept. 30, describes briefly and without giving much technical data this installation in which the power of a 300-h. p. turbine is transmitted at 1,800 to 1,900 volts and a frequency of 60 to a distant town; step-up transformers are used at the station end, transforming up from about 75 volts.

Transmission of Power.—Prof. Unwin's second lecture is concluded in the Lond. "Elec. Eng.," Oct. 20. The third lecture on transmission by wire-rope cable is given in abstract in the Lond. "Elec. Rev." of the same date.

Cost of Water Power in Switzerland.—A correspondent to the "Rev. de L'Elec.," Sept. 30, gives some figures regarding the cost of water power in Switzerland.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Large Proposed Plant at Constantinople.—A number of the European journals mention that a plan has been proposed to light Constantinople and the Bosphorus by means of waterwheels placed at three points of the Bosphorus where the current from the Black Sea to the Mediterranean has the greatest force; the scheme is said to be feasible and the Sultan has appointed a commission to report on it; it is claimed that this will be a greater accomplishment than the plant at Niagara, in which case it will be the greatest installation in the world.

Compensating Generators at Derby.—The Lond. "Elec.," Oct. 28, gives an elevation, transverse section and plan of Sayers' three-wire compensator already mentioned in the Digest Oct. 28, and based on his improvements which have been described in detail in these columns.

Frankfort o. M.—The "Elek. Rundschau," No. 2, Vol. II., devotes almost its entire issue to the majority and minority reports concerning the proposed plant in that city, which has been under discussion for a number of years.

Blackpool.—London "Lightning," Oct. 19, publishes as a supplement, under separate cover, an illustrated description of this station, which was opened a few weeks ago; the illustration includes two large interior views. The Lond. "Elec. Eng.," Oct. 20, gives, at some length, a description of this station, accompanied by a number of large illustrations; the Lond. "Elec. Rev.," Oct. 20, also describes this station, but without the aid of illustrations.

Manchester.—The Lond. "Elec. Eng.," Oct. 29, continues its description of this station.

Train Lighting.—The Lond. "Elec.," Oct. 20, states that the London, Brighton & South Coast Railway is equipping 10 more trains with the electric light, making a total of 40 trains; this system appears to be very satisfactory; it is estimated that at least 15 per cent. more work is gotten out of an electrically lighted train than out of a gas lighted train; this, alone, in the construction of a train would amount to a saving of about $225,000 in the first cost, as 85 electrically lighted trains would do the work of 100 gas lighted trains.

"Rev. de L'Elec.," Sept. 30, continues its article on train lighting, giving detailed data regarding the cost.

Gas Versus Electricity.—According to the "Elek. Echo," Oct. 14, a large wool factory in Gruenberg, Germany, replaced its 1,900 gas lights by electric lights from a private plant; the amount of light obtained was double as much, and the running cost was only half as great; it is estimated that the outlay for the entire electric plant would thus be saved in two years.

Stage Light Regulator.—The "Elek. Rundschau," No. 2, Vol. II., gives an illustrated description of the Schuckert apparatus for regulating the brightness of lights for the stage, as also for obtaining various mixtures of the three series of lights, white, red and green, in order to produce certain effects.

Incandescent Lamp Switch.—A correspondent to the Lond. "Elec. Rev.," Oct. 20, describes a double switch and its connections with two lamps, enabling them to be connected in series or in multiple or singly; when in series they burn faintly, the arrangement in that case taking the place of a rheostat for diminishing the light.

Maximum Current Cut-Out.—The "Elek. Echo," Oct. 14, describes and illustrates a new maximum cut-out, in which an iron-clad magnet, by attracting its armature, operates a small, easily moved catch, which in turn releases a large switch operated by a powerful spring.

WIRES, WIRING AND CONDUITS.

Fireproof Wiring.—The Lond. "Elec. Eng." and "Rev." of Oct. 20, give a description, accompanied by a large number of illustrations, of a system of wiring consisting essentially of conductors threaded on beads of porcelain, the whole being incased in tubes; (while there are evident advantages, there also appear to be disadvantages of no small importance).

Wiring Rules.—The Lond. "Elec. Eng.," Oct. 20, publishes a list of the regulations for wiring and fittings for the city of Manchester.

Press for Lead Covered Cables.—The "Elek. Zeit.," Oct. 20, describes at some length a new hydraulic press for covering cables with lead.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Fog Signaling.—According to the Lond. "Elec.," Oct. 20, the Great Northern Railway Company have made successful experiments and have decided to apply the system to their suburban line; the explanation is somewhat vague, but it appears to consist of an indicator and bell on the engine, which is operated by a contact made against a fixed brush near the rails, the ringing of the bell meaning that the track ahead is not clear.

Multiple Call.—In "La Lum. Elec.," Oct. 21, Mr. Zetzsche describes the new call of Mr. Wetzer by means of which any one of 12 stations can be called independently of the others; the description is accompanied by three cuts.

ELECTRO-CHEMISTRY.

Recent Progress in Accumulators.—The Lond. "Elec. Rev.," Oct. 20, contains an editorial article intended to determine whether, and if so, to what extent, progress has been made in the last few years in the manufacture of accumulators, bringing them to a level at least with the generating plant. After enumerating the desirable qualities of an accumulator, they give the results of an investigation of the Epstein cells continued over a period of five months, the outcome of which tests, they say, are highly creditable to the makers of the cells. Although in existence only two and a half years, they state that not a single plate in any of the numerous batteries erected has during this time been replaced or even repaired, and judging from their present excellent condition they think a very long lifetime may be safely predicted; the makers' maintenance guarantees of 7½ per cent. point to an anticipated life of over 13 years; their 12 batteries on the Birmingham railways have now completed 100,000 car miles without any renewals. A short description of the cell and some tests are given, from which it appears that the ampère-hour efficiency was 95 per cent. and the watt-hour efficiency 78 per cent., when the cells were charged and discharged in three hours; the plates are made by a modified Planté process, they are boiled in a liquid which renders the lead porous and prepares it for formation. In the conclusions they say that these cells show conspicuous progress in the manufacture of accumulators, and they unhesitatingly assert that storage cells now at the disposal of engineers have emerged from the state of laboratory apparatus into sound reliable pieces of machinery capable of working and with minimum attention, the annual depreciation rate of which compares favorably with any part of the generating plant.

Improvement in Leclanché Cells.—In the "Electro Techniker," Oct. 15, Dr. Grueninger discusses the subject of the formation of crystals on the zinc and concludes that the cause is due to the ammonia in the solution. It has frequently been suggested to add hydrochloric acid in order to prevent the formation of crystals, but this, he states, is soon neutralized by the zinc which is uselessly consumed. He then states that by the addition of about 10 per cent. in volume of acetic acid and 1 per cent. of wood vinegar (pyroligneous acid) he has found that the formation of crystals is entirely avoided; from a test made, lasting several months, he finds that the consumption of zinc is not greater; the E. M. F. appears to be slightly greater and the internal resistance was not increased.

Lead-Dust Accumulator.—A number of European journals mention briefly, without describing, a new method in which accumulators are now being made in Germany, which consists of obtaining a fine powder of metallic lead, called "lead-dust," and pressing this into a grid; both plates are thus made; the effect of the expansion accompanying the oxidation of the lead in the positive plate is avoided by adding to the lead powder some neutral material of a porous nature and of sufficient elasticity to allow the lead oxide to expand; the degree of porosity is one of the chief features besides the evation of the Faure patent.

Primary Batteries in Theory and Practice.—The serial on this subject, by Mr. Cooper, is continued in the Lond. "Elec.," Oct. 20, the present section being devoted to polarization, thermo-chemical relations and temperature coefficients; he explains how the electromotive force of a battery may be calculated from the energy of chemical combinations of the materials used.

Electric Tanning.—According to the Lond. "Elec. Rev.," Oct. 20, Mr. Groth has taken charge of the management of the largest tannery in Switzerland, at Orbe pres Lausanne, which is now being enlarged and reconstructed according to his system of tanning by the aid of electricity.

MISCELLANEOUS.

The New Method of Electric Heating and Welding.—The method, which has been creating quite a sensation in electric, as well as in metallurgical fields (described in the Digest April 29, July 8, Aug. 12, The Electrical World June 10, p. 430, and July 15, p. 42), consists, briefly, of passing a current through a metal immersed in an electrolytic bath. The "Elek. Anz.," Oct. 15, gives the following interesting data, as found from experiments by Mr. Julien, of Brussels. The tank used was lined with lead, the lead forming the positive pole; a continuous current must be used; the area of the positive pole must be relatively great; the choice of the liquid used depends on its conductivity and on its neutral action on the metal to be heated; in the present experiments a solution of chloride of calcium of 20 degrees B. was used; the evolution of gas at the negative pole, forming a great resistance, is supposed to be the cause of the heat, but he says the researches have not yet determined definitely the true explanation of the phenomenon; the best source was found to be a shunt dynamo in parallel with accumulators. The regulation of the current is of great importance; on the first immersion a relatively high E. M. F. is required to reduce the oxide and clean the iron, the E. M. F. must therefore be regulated; on removing the piece from the liquid the portions leaving last are apt to be heated to too high a temperature. With this liquid 110 volts are required for heating cylindrical iron rods of five square centimetres (or about ¾ square inch) surface to a welding heat, and for every additional 5 square centimetres an increase of 10 volts is necessary; but these values change for large surfaces and seem to be different for different metals; for more than 250 volts the bath must contain less salt or else the decomposition will be too violent; the time required depends entirely on the voltage. Regarding the current, he states that after the formation of the layer of gas 4.5 to 5 amperes per square centimetre (29 to 32 per square inch) are required in order to bring it to a welding heat; the temperature of the bath is also of importance, and it has been found that the best results are obtained at 70 degrees C. (about 157 degrees F.), at higher temperatures the layer of gas is not continuous. From a table of data giving the current, the time and the consumption of energy at various temperatures for a piece of iron of 16 square centimetres surface, it appears that at 20 degrees C. it took 100 amperes for 13 seconds, and at 70 degrees it took 80 amperes for 8 seconds; at 90 degrees the action became irregular, and at 95 degrees the layer of gas was no longer formed. To heat 1 cubic centimetre of iron to a white heat, 7560 watt seconds are required theoretically, for steel, 8000 and for copper, 5250; for a certain piece of iron 4⅛ seconds were required theoretically, while in an actual experiment it was found to take 10 seconds, showing an efficiency of about 45 per cent; this efficiency becomes better when the time is shorter, and worse when the time is longer; in experiments made with the fusion of metals, at which a much higher voltage was used for a shorter time, the efficiency was much better; recent researches with rods of graphite have shown that by this means much higher temperatures can be produced with less consumption of energy, than in the electric arc. One of the useful applications of the method is in tempering steel, in which case the temperature can be regulated very closely and the actual tempering produced by simply breaking the current and leaving the steel in the liquid. Experiments made with different degrees of density of the solution showed a great difference in the time of immersion required when other conditions were the same. (From other sources it appears that the corners of a piece of metal are apt to be burnt, as the heat developed is greater there; also that it is important not to immerse the metal too deeply, the best results being obtained by simply touching it to the surface of the liquid.)

Electrical Regulator Clock.—The Lond. "Elec. Rev.," Oct. 20, gives a good illustration and description of the new system of Mr. Campichi, of Geneva, already mentioned in the Digest. It is a clock, or rather a simple pendulum operated electrically, which sends an impulse through the lines to other clocks once every minute; it seems to be the simplest arrangement of the kind which has yet been brought out. A pendulum, beating seconds, operates a second wheel which once in every revolution closes a circuit leading to the secondary clocks, and at the same time passing through an electro-magnet near the pendulum, the armature of which, on being attracted, gives a fresh impulse to the pendulum sufficient to oscillate it for the next minute. (An objection which suggests itself is, that this master clock is dependent on the condition of the line wires of the battery—thus, if they are open, or leaking badly, or if the battery is weak, the impulse given to the pendulum will be affected, and as this impulse occurs only once a minute, the pendulum would probably come to rest if a single impulse were omitted.)

Carbon and Silicum.—The furnace for making a combination of carbon and silicum, as described in the Digest last week, is illustrated in "La Lum. Elec.," Oct. 21; illustrations are also given of the magnified crystals.

Carborundum.—"La Lum. Elec.," Oct. 21, reprints a paper by Mr. Atcheson on this material.

Lightning.—"La Lum. Elec.," Oct. 21, reprints from a medical journal a description by Mr. Chenet of a curious experience in which, while traveling in a storm, he was enveloped in a blinding white sheet, formed by some sort of electric discharge; the discharge repeated itself several times, sometimes enveloping himself, sometimes his companions and his horse; a number of marks were left on his body, which disappeared after ten days. Such discharges are said to be quite frequent in the island of Java; a peculiar feature of this discharge is that the person enveloped does not seem to hear the thunder, while others around him do.

Educational.—Mr. Maycock, in the "Lond. Elec. Rev.," Oct. 20, discusses "The Advantages Attending the Multiplication of Electrical Students and Would-be Electrical Engineers," and "The Necessity for a New Subject of Examination by the City and Guilds of London Institute."

Notes on Recent Developments in Electricity Abroad.—Part I.*

BY CARL HERING.

Busy men, as most conscientious electricians are, generally have little time to study the vast amount of periodic literature published weekly, even if the journals were all accessible to them, and the foreign languages in some of them were no hindrance. For the benefit of such busy men the following notes were compiled from articles in the principal foreign electrical journals for the present year; as they are all taken from periodicals they necessarily contain nothing which has not already been published, and they are therefore intended to form a mere résumé or index to call attention to what has been done, leaving those who are interested in any of the subjects to look up further details for themselves.†

ELECTRO-PHYSICS.

Taking up first the subject of electro-physics, I will limit myself to only a few of the more interesting papers, as most of that which has been published in this branch belongs to the subject of physics rather than to electrical engineering.

Mr. Arno has shown that a rotating electric field, quite similar to the well known rotating magnetic field, can be produced, and that this can be applied to the construction of an electrostatic rotary field motor; it is only of theoretical interest, as the power developed is necessarily exceedingly small. There has been some discussion as to whether there is such a thing as electrostatic hysteresis, on which this phenomenon is supposed to be based, but authorities still differ.

Prof. Elihu Thomson stated that he has succeeded in making a transformer in which a continuous current is made to give alternating currents of any desired frequency, and which contains no moving parts. Several other writers have shown that the frequency of an alternating current may be tripled and doubled quite readily in an alternator without increasing the speed. Dr. Sahulka has shown that a condenser may act as a transformer of current into phase, so to speak; that is, that a condenser in parallel converts a weak current of small phase difference into a strong current of large phase difference, and vice versa.

Several instruments have been described by means of which the curve of an alternating current can be resolved into its component sine curves.

Dr. Heydweiller has made a long series of tests with striking distances, giving quite a complete table of the results, which we think can be used to advantage in place of the very old table of De la Rive, which has been the standard of reference for so many years. The much vexed question of the sparking distances has also been discussed by Mr. Peace in a Royal Society paper, in which he gives what constitutes, probably, one of the most complete and reliable tests made for certain ranges. Mr. Precht has shown that lightning rod points begin to discharge only when the potential has reached as high as 15,000 volts, and even extremely fine points can be charged to 2,500 volts before they will discharge continuously; also that a bunch of points must be charged to a higher potential than a single point in order to discharge; he believes that in many cases the points of lightning rods are inactive. The difference of potential of the air at the top and at the bottom of the Eiffel tower was found to vary from 3,000 to 7,000 volts, increasing sometimes to 10,000.

Mr. Arons described an arc lamp in which the arc is produced in vacuum between electrodes of mercury, showing some interesting results; the voltage and the current are quite low, but unfortunately the amount of light generated is not given.

In an interesting experiment made by Dr. Gore, he has shown that pressure may be converted into current; the pressure is applied to an electrolyte, which then generates a current at the expense of nothing but the pressure.

A number of improvements have been described by Wimshurst and others in so-called electrostatic machines.

Numerous experiments have been described with stretched wires through which a current is passed; under certain conditions the wire will vibrate, some parts becoming luminous, while others remain cold; in another case the wire itself became deformed as if it had been placed between two files.

A number of articles have been published on the electrical transmission of sight, but although interesting, they appear to contain nothing new or of any great importance, and the matter may still be considered as an unsolved problem.

Much has been done in the line of the researches started by Hertz, but this is beyond the province of the present paper.

Prof. Dewar has made some very interesting experiments with liquid oxygen, which he now makes in large quantities: liquid oxygen is magnetic, and he has shown that in liquefied air the magnet will not suck out the oxygen, even though the nitrogen is not magnetic; but the most interesting parts of his researches, for electricians, are those which show that the resistance of all pure metals is probably zero at the absolute zero of temperature, or, in other words, at that temperature electricity will pass through pure metals without any C^2R loss; alloys, however, do not follow this rule. Prof. Dewar has also succeeded in converting air into a solid. It has been stated that the magnetic moment of oxygen is about one-thousandth that of iron, and that liquid oxygen is an excellent insulator.

Much has been written on the electro-magnetic theory of light, but it is beyond the province of this résumé. An English scientist stated that electro-magnetic waves are strictly similar in their nature to light waves, differing only in the wave length. The light waves are about one-fifty-thousandth of an inch long, while the electro-magnetic waves that have been investigated are from a few inches to many yards in length.

Messrs. Lagrange and Hoho gave what appears to be the first public exhibition of the phenomenon, now so well known, of heating a metal by its contact resistance with water. The heat produced is exceedingly intense, and is generated very rapidly—two qualities which may make the process one of considerable commercial value.

It is claimed by Mr. Sandford that Ohm's law should be qualified, as he believes to have found that the nature of the medium surrounding a wire has an appreciable effect on the resistance of the wire; his conclusions, however, do not appear to be generally accepted, and it will be fortunate if it turns out that he is not correct.

Mr. Packey claims to have found by photography that there is what he calls an electrical spectrum different from the remaining part of the spectrum, and that it contained only the "electric rays" of the spectrum.

Several papers have been written showing how the amount of light can be measured by absolute instead of comparative methods, but none of these appear to have as yet been put into the form of a practical photometer.

A number of interesting phenomena have been described with high tension and high frequency currents which, however, time does not admit of mentioning here. Much has been written lately endeavoring to explain the phenomenon that an incandescent lamp may be brought to great brilliancy by high tension, high frequency currents of exceeding small amperage; most of the writers claim that it is due to skin deep conduction, but this has been seriously questioned by several equally high authorities, and it can therefore still be considered as a phenomenon which cannot be explained. Dr. Leduc has shown that high tension alternating currents produced by electrostatic machines have properties which are analogous, but not identical with, those which Tesla uses. Mr. Rimington has shown that many of the phenomena with vacuum tubes can also be produced with such tubes when they contain no electrodes, and when they are placed in electrostatic fields. Lord Armstrong showed an interesting experiment, in which a cotton thread was carried bodily from one glass of water into another by a current from an influence machine.

A new and important redetermination of the mechanical equivalent of heat has been made by Messrs. Griffiths and Clark; they found it to be 778.99 foot pounds.

Among the interesting articles of speculative nature is one in which a French writer endeavors to show that the absolute temperature has the same dimensions as electrical potential.

MAGNETISM.

Mr. Meylan has shown that the great care taken by some makers to have perfect joints in dynamos is not justifiable, as the additional excitation required to overcome the effects of joints in a magnetic circuit is only about 1 to 2 per cent.; in transformers, however, the question is quite different, for if joints could be avoided, there would be a gain of 10 to 15 per cent. in the magnetizing current; he believes furthermore that the predetermination of the characteristics of transformers having a closed magnetic circuit is very uncertain, and probably of little practical value.

Mr. Abdank Abakanowicz has described an interesting arrangement by means of which the effects of hysteresis may be compensated in measuring instruments by the simple addition of a second electro-magnet, properly designed and proportioned.

In Russia a local north pole of the earth's magnetism has recently been found, thus showing that there are at least two north poles of the earth.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Many new instruments and new methods for making various measurements were described, but they are too numerous to mention here. Those interested in the measurement of self-induction will find several articles on the subject in recent numbers of *La Lumière Electrique.* Prof. Fleming, in his recent Cantor lectures, has given a very good summary of the subject of the practical measurement of alternating currents.

The very extended researches which have recently been made with the Clark standard cell seem to show that it may now be considered as a very reliable and accurate standard, provided it is properly made. On the other hand it appears that the Daniell standard has been abandoned, at least when accuracy and reliability are of great importance. It appears that the Clark cell may now be relied upon within one part in ten thousand, that is, within one hundredth of one per cent.

A number of tests have been made of the Elihu Thomson wattmeter, all of those published giving very favorable results; this, coming from abroad, is significant. Prof. Fleming called attention to the fact that meters placed in cellars are often subjected to great changes of temperature, producing an error of from 10 to 15 per cent. in the readings, a subject which he thinks ought to be considered more than it is in designing meters. Several forms of ohm meters have been described, chiefly for use in measuring high resistance and insulation. The literature on the copper voltameter has received an important addition by the paper of Dr. Ottel; he shows among other things that the addition of alcohol makes the actual deposit more nearly equal to that required by theory; also that an acid solution is better than a neutral one.

Much has been written about locating faults in underground mains, but most of the methods are either impracticable or rather cumbersome, requiring the patience of a German to apply them. Apparently successful high resistances have been made, consisting of rods of a mixture of plumbago and clay. An interesting and simple method for measuring the magnetic qualities of iron was described by Dr. Behn-Eschenburg, in which the underlying principle is that the magnetic circuit is suddenly broken, which enables both the permeability and the remanent magnetism to be readily determined with very simple apparatus.

Much has been written, especially by the French and Germans, regarding the behavior and the calculation of condensers for commercial use in alternating current circuits; although interesting, the results will be of little use until condensers become cheap enough to be used in practice. A feature of interest, if true, for all condensers, was reported in an English paper; it was shown that a condenser which was excellent at normal temperatures, was shown to have very bad insulation when the temperature approached the freezing point of water.

Recent experiments with the arc have apparently shown that its temperature is constant, being about 3,500 degrees C, and that the amount of light emitted per unit area of crater surface is also constant, for which reason some have urged to adopt it as the unit of light; the amount of light given off per square millimetre of crater surface is given as about 70 candles. A French scientist suggests a photometric standard made of phosphorescent zinc sulphide, which in common language might be called luminous paint; if exposed to the light it will afterward emit light, the intensity of which seems to be independent of the original source of illumination, of its duration, or of the thickness of the layer. Among the different forms of photometers the Lummer-Brodhun type seems to be meeting with more and more favor. Several curious forms of photometers have been described, in one of which light is absorbed and measured by a semi-translucent screen of increasing thickness, and, in another, letters printed on successive sheets, each one with a darker background than the preceding, are used, but both are, of course, only very crude instruments.

For measuring extremely high temperatures, as in furnaces, and also for extremely low temperatures approaching the absolute zero, physicists seem to have found electrical methods the most reliable. For high temperature thermometers Dr. Barus concludes from a long series of experiments that a couple made of platinum with an alloy of platinum and iridium or rhodium gives the best results.

Mr. Lagarde has made a redetermination of the specific resistance of pure copper, and finds it to be 19.58 ohms, presumably legal ohms, at 0 degree C. for a wire 1,000 metres long and 1 millimetre in diameter. He also found that the temperature coefficient .00445 is fairly constant between 0 and 40 degrees C., and that it is directly proportional to the conductivity of the copper.

A writer in a German paper calls attention to the fact that the shape of the waves of an alternating current will have quite a perceptible effect in the reading of a voltmeter and in the working of an alternate arc light, and he concludes therefrom that both should be adjusted with currents from the same generator with which they are to be used.

A French writer has devised an analytical method for determining the shape of the curves of alternating currents, consisting of an experimental determination of the successive terms in the Fourier series, from which the curve can then be deduced. The measurements are made with auxiliary apparatus used in connection with the alternator.

There was much discussion in foreign journals regarding the work to be done by the Chicago Congress, but as all this was entirely ignored by the delegates to that Congress it may be passed over here. Although it has been of little use, it was none the less interesting and instructive,

* A paper read at the last meeting of the Electrical Section of the Franklin Institute.

† More complete abstracts of all of the articles referred to will be found in the "Digest" in THE ELECTRICAL WORLD from Feb. 4, 1893, to date.

Mr. Martin's Lawsuit—Its Object Cash, Not Vindication—Fruitless Exertion—Why and How It Failed.—VII.

In this issue we bring our report of the Martin case to an end, by publishing the cross-examination of Mr. Johnston, and the testimony of Mr. Wetzler, which completes the report of the evidence given in the case.

MR. JOHNSTON'S CROSS-EXAMINATION BY MR. MASTEN:

The labor of Mr. Martin undoubtedly contributed to the success of The Electrical World. I regarded him as a very capable man, outside of certain peculiarities. His standing, I think, is not as good now as it was. My impression is that his entire reputation and standing in electrical matters developed after he became editor of The Electrical World. The fact that he was connected with The Electrical World would naturally make him very widely known among electrical people. I exercised very little supervision over the editorial department. I wasn't in the habit of interfering or giving orders about the various details of the work. Mr. Martin was not held to any particular time of coming to work. He would come at 11 o'clock, if he wished. He would go home when he felt like it. Up to the occurrence of Feb. 8 I took no steps whatever looking toward the removal of Mr. Martin. I had cause for complaint during the year 1889, principally, however, in reference to Mr. Martin's conduct toward me. Up to Feb. 8 I regarded his services as valuable to the paper, and naturally preferred to keep him. Mr. Martin, however, acted in such a manner after the company was formed that I was afraid I could not. I first commenced negotiations for the employment of another editor on Feb. 10, two days after Mr. Martin's—

Here Mr. Martin's counsel stopped the witness from answering further on this point.

I first decided to discharge Mr. Martin after this Saturday, Feb. 8. I had done my best to keep on good terms with him prior to that. Mr. Colvin was never instructed to withhold any letter or editorial matter for any length of time whatever. The editorial matter went through Mr. Colvin's hands simply to keep a record of it. For some days prior to Feb. 8 I hadn't seen much of Mr. Martin. On Feb. 8 I was in the office in the morning. I had no communication with Mr. Martin that morning. I saw and spoke to Mr. Stump. I asked him whether he had got the paper to press, and he said all the advertising pages had been made up and were ready. The reading forms were a little behind; they would probably go down about 10 or 11 o'clock, or some time during the day. Before I went up town I said to Mr. Kornfeld that there must be no failure about the paper going to press, and to go over to the printer's and see how things were and then to the press room, which ordinarily closes at 12 o'clock on Saturdays, but which I asked him to see did not close that day until they got our forms. I came down town again to see that everything had gone to press, reaching the office about half past four. I met Mr. Kornfeld, and he said that Mr. Martin and Mr. Wetzler were deliberately delaying the paper; that he didn't think they wanted to get it to press that day. He was then on his way to pay them their salaries, and I said, "if that be so, I will go with you," so together we walked over.

Q. That was a source of considerable surprise to you, was it not? A. I certainly felt very much disappointed.

Q. And did you then know any reason why Mr. Martin or Mr. Wetzler should have intentionally delayed getting out the paper that day? A. I did not, unless it should have been from vindictiveness.

Q. You knew no reason, unless it should be from vindictiveness? And did you know any reason why they should do it from vindictiveness? A. I know that at a meeting a few days preceding they had endeavored to have a resolution passed which the other members of the Board of Directors did not seem inclined to pass, and that was the only reason I could infer.

Q. The resolution with regard to representation of the paper at the convention? A. The resolution I refer to was one in reference to closing the stock book so that no transfers of stock could be made. They offered the resolution that the stock book be closed and kept closed until after the annual meeting, on the presumption that no stock could be transferred, and therefore no directors put in to take their places. The other members of the board of directors refused to do this, and they were exceedingly angry and refused to speak with them in reference to the business of the company.

The meaning of closing the stock transfer book may not be apparent to all readers. A few words, however, will make it so. This meeting of the board was held early in the year 1890, before the election, which took place, as Mr. Martin said, on Feb. 19 or 20, 1890. At this election new directors were chosen—one in place of Mr. Martin, and also a vice-president in his place; and the men so chosen had to become qualified for these offices by becoming stockholders. If the books were closed, Mr. Martin argued, they could not become stockholders, as no stock could be transferred to them, and consequently they could not be qualified to hold the offices of director and vice-president, and of course Mr. Martin would remain a director and the vice-president for one year from the date of the election. He was discharged about two weeks afterward, on March 5, and he went immediately to fill a vacancy either then existing or made for him on the editorial staff of the "Electrical Engineer," and all friendly interest on his part in The Electrical World ceased. Still, had Mr. Martin succeeded in closing the books and preventing a successor being elected we would have had a member of the editorial staff of the "Electrical Engineer" for one of the directors and vice-president of the W. J. Johnston Company. Likewise, in another member of the editorial staff of the "Electrical Engineer," Mr. Wetzler, we might be gratuitously supplied with another member of the board and also a secretary. As a household arrangement, a domicile in which is included a mother-in-law—at whom, poor, dear woman, humorists like to poke fun—could not begin to compare with this. The members of the editorial staff of the "Electrical Engineer" sitting as members of the board of directors of the W. J. Johnston Company, and acting as its vice-president and secretary! Mr. Martin thought he knew what he was about when he wanted this book closed.

Q. And who were the other members of the board of directors—Messrs. Stump and Hunt? A. Yes.

Q. Now, I understand that is the only reason that you could then give, or can now give, for Martin and Wetzler wishing to delay this paper—for vindictiveness? A. I was not looking for any reasons. I understood the paper was not going to press and wanted to know why it wasn't.

It was not necessary, nor was it reasonable, that Mr. Johnston should be expected to supply reasons for Mr. Martin's strange actions. Men have oftentimes been convicted of crimes—and even put to death—and no reason was ever given why they committed the crime. All the law requires is evidence to establish its commission. The reader who has followed the facts will no doubt be able to supply himself with satisfactory reasons why Mr. Martin delayed issuing the paper.

Q. After you had this conversation with Mr. Kornfeld and he made this statement to you, you went over to the printing office; what time did you arrive there? A. About quarter of five.

Q. And there, as I understand, you first announced yourself to Messrs. Martin and Wetzler? A. No, sir, the first one I spoke to was the foreman of the office.

Q. Mr. Newman? A. Mr. Newman, who testified here.

Q. What did you say to Mr. Newman? A. I said, "What is the matter with the reading forms this week?"

Mr. Newman replied: "Why, we haven't got all the copy yet; we haven't a line of editorial copy." I turned to Mr. Martin and said to Mr. Martin and Mr. Wetzler, who stood together: "Have you not turned in your editorial copy yet?" Mr. Martin said "No." I said "Why not?" They shrugged their shoulders.

Does any one believe for a moment when Mr. Newman said: "We haven't a line of editorial copy," he told anything but the truth? If Mr. Martin was correct in saying he believed he handed the copy to Newman, Mr. Newman then had it in his pocket and refused to produce it? That is not one bit likely.

Q. Both shrugged? A. Mr. Martin did, and said he didn't have time.

Q. Then what? A. By that time the workmen were putting on their coats and going home and Mr. Martin and Mr. Wetzler did the same thing. I said in astonishment to Mr. Martin and Mr. Wetzler: "Are you not going to stay and get the paper to press? We must go to press to-night, because the train leaves at nine o'clock in the morning. Mr. Martin replied in a very insolent way: "We work regular hours now, and you will find that five o'clock is the usual time for printers to stop on Saturday." Mr. Martin and Mr. Wetzler deliberately went home, leaving the forms in such condition——

Again the witness was interrupted.

Q. Then, as soon as they had gone, do I understand that you fell to to make up the paper? A. Yes, sir.

Q. What did you do about having the printers stay? A. I paid them a dollar an hour each extra to remain. I made no particular effort to find editorial copy. Mr. Martin and the foreman said there was none, and I took their word for it. Mr. Martin told me very distinctly that there was not. Mr. Martin was exceedingly gruff. He said nothing to me about feeling ill or about being up the previous night, or about having illness in his family, or whether it was my wish that he should stay and make up the paper, or whether Mr. Wetzler should stay alone and make it up. He did not ask me to go away and allow him to complete his work, neither in those words or in substance. Nothing of the kind or anything anywhere near it. I don't think Mr. Martin addressed any remark to me that I refused to reply to. He did say he worked regular hours, and five o'clock was the time to quit on Saturday, and he was going home. I think I was too surprised to make any reply to that. There was no offer on his part to stay and put the paper to press; on the contrary, he refused. Mr. Martin, instead of coming and going at regular hours, asked to go away when he felt like it, and said he would be responsible for getting the paper to press on time.

There can hardly be anything more cheeky than the asking of the questions which called forth these answers, in the face of the testimony of Kornfeld, Smith, Weithas and Newman, and even that of Martin and Wetzler themselves. Mr. Martin, when on the stand, at no time pretended to say that he told Mr. Johnston he was ill or that he asked him to allow Mr. Wetzler to stay alone and finish the paper. But supposing he did ask that Mr. Wetzler should be allowed to stay alone, as the question implies, why did he suggest Wetzler staying alone and his leaving? Did he want to leave?

Q. You attended to the business department? A. Yes.

Q. I mean except when you were in Europe? A. Yes, and then I did some business.

Q. You were in the habit of going to Europe on business? A. Yes; on business and pleasure combined.

Q. And sometimes were gone as long as six months at a time? A. Never.

Q. You have been gone five months at a time? A. I don't think so; I think four months was the longest.

Q. You had a country place at Greenwich for some years? A. Yes.

Q. You have been in the habit of spending some time there, haven't you? A. Very little.

Yes; very little. Mr. Johnston merely slept and spent Sundays there. But what the object of this examination was except to kill time in the hope that something might once again "turn up" it is hard to tell. It is not to be supposed that Mr. Martin seriously thought that the fact that Mr. Johnston made an occasional trip to Europe, or had a "country place at Greenwich for some years," had any bearing on the question at issue, or that such would influence the court which was trying this case. Neither were these things to be ashamed of. The case was not before a jury of socialists, nor a jury at all. There is a curious coincidence in this line of questions with Mr. Martin's ideas about division when he came to Mr. Johnston, with the "intention" of resigning because he could not get a share in the business.

Mr. Colvin never handed over the mail to me. He consulted me. Not at that nor at any time did Mr. Colvin hand over the mail to me or delay it, so far as I know.

This is corroborated by Colvin's evidence, where he said, speaking of the mail, he "sometimes delivered it to them direct, and sometimes took it to Mr. Johnston before delivering it, for his action." Mr. Colvin may have said this unconsciously, as he afterward tried to qualify it by saying, "It was opened by a lady clerk, then handed to me, and I held on to it until after Mr. Johnston saw it." Colvin's answers are not consistent; and his first is more likely to be correct than his last.

It is not a fact that I prepared or caused to be prepared a written statement giving my version of the occurrence at the printing office and presented it to Mr. Newman and Mr. Weithas for their signature. I may have seen statements from either of these gentlemen. I don't know that any such statements were prepared. I may have seen some writing. I prepared no statement. Such was never presented to Mr. Newman or Mr. Weithas at my request. I don't know that Colonel Dillont entertained Mr. Weithas at dinner. I didn't pay the bill for such dinner. I didn't prepare or caused to be prepared a written statement for Mr. Kornfeld. I know Mr. Kornfeld made a statement in writing. He made it voluntarily, entirely. I have not got it in my possession.

The matter which I sent from Kansas City was addressed to The Electrical World, as far as I remember. I don't think it was addressed to either Mr. Martin or Mr. Colvin. It was to The Electrical World, simply. I probably wrote Mr. Colvin about it, and not Mr. Martin.

Why should Mr. Johnston send anything to Mr. Martin? For aught he knew Mr. Martin was not in the office.

This telegram from Kansas City was received on Thursday, but dated the night before. Probably the greater part of the matter sent from Kansas City was sent on Wednesday. I think Wednesday's batch was the heaviest. When I reached New York on Monday Mr. Martin made complaints in a general way. I don't think there was any specific complaint. He said some of the matter had not reached him until Monday morning. He may have said most of it had not reached him until Monday morning.

Q. Now, as I understand, when you came back you said you discovered nothing had been done to speak of on the paper for the issue of the 22d? A. I don't think I said that; I think I said I didn't think as much had been done as I thought ought to have been done.

Q. You considered it a simple matter for the convention to be reported? A. By a person not on the ground—the simplest thing in the world.

Q. Did he know better than a man who had been at the convention? A. It may have been somewhat different, but I had edited a great deal of the copy; instead of attending the excursions and entertainments, I had edited it so that it was in correct shape.

Q. You mean almost ready to go to press? A. Yes; it simply needed a little cutting down. That may not have been so with it all, but in the first few days it was.

Q. Now, on the direct examination, in reply to Mr. Keigharn, you testified that you had nothing whatever to do with reporting that Kansas City matter, except to go through and correct some errors in the names, and elaborate some little points that you thought ought to be elaborated, and to cut down some points that you thought ought to be cut down. What do you wish us to understand as the correct answer; the one you gave Mr. Keigharn, or the one you have now given? A. That this matter was reported, word for word, as it was given in the meeting, and all that was necessary was to go through and make changes here and there. That I had done.

Q. Do you wish us to understand that that matter was, the most of it, practically edited so as to make less work for Mr. Martin; or do you wish us to understand that you hadn't done anything with it? A. Oh, I had done considerable with it. I had made some corrections, and put the matter in such shape all that was necessary——

Q. (Counsel interposing). Mr. Keigharn asked you: "As a matter of fact, did you have anything to do with reporting the Kansas City Convention?" and you answered: "Nothing whatever, except to correct some errors." A. That answer was correct in this sense——

Q. (Counsel interposing). Was it correct in the same sense that you answered my question to-day? A. They are both correct. Mr. Martin had complained—

Q. (Counsel interposing). I want to know which was the fact, was the stuff edited, or not? A. Partially edited.

The unfairness of this method of examination will be apparent to any one, the counsel continually interrupting to stop the witness when he foresaw that his answer was not what he was seeking. Any one who has read this report can see that when Mr. Johnston said on his direct examination that he had nothing to do with the reporting of the convention, he simply said and meant to say that Mr. Martin had made the arrangements for the report, and this he proved by producing the proposition made to The Electrical World to report the convention, with Mr. Martin's written acceptance of it in these words: "We will go in on this. T. C. M." If the report was defective, as Mr. Martin's counsel now claimed, it was all the more reason why Mr. Martin should have made it correct, as the persons who made the report were of his own selection, and did the work for The Electrical World by his sanction and approval.

Q. As a matter of fact, the matter was in such shape that Mr. Martin, in order to get it ready for the press, would have to re-write it, practically? A. Oh, no.

Q. Wouldn't he have to re-write it in greater part? A. No.

Q. Why not? A. Simply because it was not necessary.

Q. Because of the work that you had done upon it? A. No, sir; but because it was not usual to do so.

Q. Then do I understand that it was possible to put this matter to press substantially in the form in which it came? A. It could have been so put in the form.

Q. But did you expect it would be so put in the form? A. There was nothing required of a man on the spot that I hadn't supplied in the copy.

Q. How much work was there, in your opinion, necessary in getting this matter into shape as it came from your hands to put it to press? A. It would be exceedingly difficult to say. One editor would spend five times as long as another, but it would have been no particular strain on the brain tissue to get that matter to press in due shape from the material Mr. Martin was furnished.

Q. Do you think, for instance, if half of it had reached him on Saturday, and the remaining part reached him on Monday morning, that he should have had the whole matter ready for the press by Monday at noon? A. No, sir; I don't expect impossibilities.

Q. Suppose there were nearly 300 pages, and of that amount only 100 had been delivered on Saturday, the balance coming in on Monday, do you think you could have got it ready for press Monday noon? A. No, sir.

This question and the one just before it are unfair, for the reason that both assume what was neither proved nor admitted—that a large part of the report reached Mr. Martin on Saturday, and not before. Mr. Martin himself said none of it reached him until Monday. Mr. Wetzler said they got some on Saturday. Mr. Johnston's evidence, which was corroborated by the telegram, about which there could be no dispute, showed that it should have reached The Electrical World or Colvin, who had charge of the mails, in sections on Thursday, Friday and Saturday. Mr. Colvin was not called to dispute this. The question, therefore, was: Did Colvin turn it over to Mr. Martin promptly? It lay between Martin and Colvin. If Mr. Colvin, or any other subordinate, was withhholding the report, why did not Mr. Martin make him give it up? At that time, according to his own letter, he was exercising exclusive authority in the office and over Colvin. This we made clear before.

Because of Mr. Martin's failure to write editorials for the issue of Feb. 22, Mr. Knight and I wrote them. I don't believe I could mark those we wrote now. Mr. Martin wrote some; it is possible Mr. Wetzler wrote some. I know items were written by me and others.

Q. Won't you state exactly, to the best of your recollection, what the conversation was between you and Mr. Martin in regard to the manner in which he was getting along with his work? A. He said: "I knew you would muddle up the Kansas City report; I knew you weren't competent to make the report. We will do the best we can, but just when the paper will come out we can't say."

Q. Then, that was at the time Mr. Knight was present? A. I am not quite so positive of that.

What difference did it make whether Johnston was positive or not about this? Knight was positive, and Martin has never denied what Knight said occurred.

Q. Why aren't you as positive of it now as you were the other day? A. I don't know.

Q. You testified the other day that Mr. Martin turned around to Mr. Knight and made that remark? A. No; it was another remark he made to Mr. Knight.

The witness was correct here and the learned lawyer was in error. What Mr. Johnston said was that Mr. Martin turned around and said: "I don't think I have been introduced to this gentleman, but if he comes to take a position in this office, I want to warn him that Mr. Johnston will take advantage of him, as he has taken advantage of me." But what was the sense of all this badgering of the witness? There was no disputing that this occurred. Knight swore to it; and when the counsel tried to shake Knight, Knight repeated it. Martin has not denied what Knight said, and at the time all these questions were being fired at Mr. Johnston Mr. Martin had not the slightest intention, we are quite sure, of denying any part of what Mr. Knight said occurred. We certainly hope he had no such intention, as to do so would reflect on his own witness, Mr. Knight.

It was about half-past 12 when I took the copy away from Mr. Martin. He did not ask to retain it. Mr. Wetzler may have been present. At the time I in no way, shape, manner or form relieved Mr. Martin from his duty on that occasion, nor at any other time until he was discharged. I think I asked Mr. Martin what his conduct meant; that I could not understand it, and he replied: "I am living up to the very letter of my contract, and I don't know what you mean." I don't recollect that Mr .Martin with Mr. Wetzler applied to me in the afternoon for permission to go on and complete the work which had been taken away. I should have been very glad to have given it to them. I think Mr. Knight was in my room during the afternoon when they were there. I went right to work and finished the copy and sent it to the printer. I didn't say in the presence of Knight that I certainly would not have them do it. I felt at that time that I did not want to leave it to them to do. I put nothing in the way of their going on with their work. I didn't decline to let them go on with it.

Q. Do you recollect when Mr. Knight first did anything for you? A. He went to Kansas City with us.

Q. Didn't you, while he was in Meriden, have him attend to some business for you? A. I think I had him write a letter. That letter had not any regard to the employment of an editor to take charge of The Electrical World.

Q. During this year 1890 weren't a number of applications made to you as president of the W. J. Johnston Co. for information in regard to the condition of its affairs by Mr. Martin? A. Not until this row began.

Q. Or by any other of the stockholders? A. No, sir.

Q. When you say "this row" you mean the occurrence of Feb. 8? A. No, sir. In November I undertook to discharge Mr. Wetzler, and Mr. Martin objected, and from that time unti lhis discharge he acted in a most offensive manner.

Q. The question I asked you was in regard to the year 1890, if efforts were not made by Mr. Martin and other stockholders to get you to make a statement in regard to the affairs of the company? A. Yes.

Q. Frequently, were they not? A. Yes.

Q. And you didn't give it, did you? A. No, sir.

Q. As a matter of fact, there was no stockholder of the W. J. Johnston Company during the year 1890 who saw the balance sheet, excepting yourself, was there—I mean between January and the discharge of Mr. Martin? A. There were only five stockholders.

Q. Were there any who had seen it excepting yourself? A. Not that I remember.

Q. And you don't deny that Mr. Martin, Mr. Wetzler, Mr. Stump and Mr. Hunt had, all of them, asked for a statement of the business of the company? A. Well, I think they asked it more in the way of——

Q. Did they, or did they not? A. They probably did.

Q. And you didn't give it? A. I gave them permission to examine the books if they would send a man to do it.

Now let us look at this "statement question"; and we can show the trick which is covered up in this absurd claim. In the first place, we will admit that Mr. Martin was entitled to a statement; to a correct statement. But why did he want the balance sheet? He has never told us why, and we do not claim that there was any obligation on him to tell us. But suppose he wanted it for the honest purpose of supervising Mr. Johnston's actions—in plain English, of finding out whether Mr. Johnston had defrauded him in not paying him more than $2,500, as the guaranteed dividend on the stock. Then he must admit that for the sake of justice it was desirable that the statement furnished should be in every sense a correct statement of what was strictly the net earnings of the company. The statement—the balance sheet—which Mr. Martin insinuates was improperly withheld, is one of those very same statements which Mr. Morton, the expert accountant of Mr. Martin, referred to on his examination, and which he admitted on his cross-examination was not correct in these particulars. That it did not allow anything for bad debts, that it did not allow the $10,000 paid Messrs. Wetzler, Martin, Stump and Hunt, and did not allow any salary for the president. This incorrect statement Mr. Martin wanted Mr. Johnston to furnish him as a statement of the net financial earnings of the company. Had he done so Mr. Martin would have been abroad inside of 24 hours, claiming that, as to this statement, Mr. Johnston had furnished it, and thereby had elected to treat it as correct. Here we would have had another letter of June 7. Mr. Martin knew, or thought he knew, what he was doing here. But Mr. Johnston knew also what he was about. He steered clear this time of Mr. Martin's efforts. As Mr. Johnston said, the statements furnished gave him an idea of how the business was running. The dividend was below $2,500, even as the balance sheet stood, and it was of no consequence to Johnston, as he had to pay that sum anyhow to Martin under the guaranty; but, although it was below it as the statement stood, it would have been more so had the statement been strictly correct, had the bad debts, the $10,000, and the salary of the president been taken out. This is the trick which is covered up in this statement question. Mr. Johnston allowed them to make up their own statement, which was not what they wanted. Mr. Martin knew what he was at.

Q. Did or did they not get this information that they asked from you? A. I think they did. The representative of Martin and Wetzler, the accountant, got all the information there was.

Q. He got it after a mandamus, didn't he? A. No, sir; he did not. He got it without a mandamus.

Why should Mr. Johnston be asked such a question as: "He got it after a mandamus, didn't he?" If the pronoun "he" referred to Mr. Wetzler, the counsel knew that Mr. Wetzler never got anything by mandamus—as the application for a mandamus, which was made by Mr. Masten, was denied by the Court. If the counsel referred to Mr. Martin he was equally incorrect, because he knew that Martin got no mandamus until months afterward, and got it then by the methods we have shown. "His representative" could not have secured this examination at that time by this mandamus.

Q. Now, isn't it a fact, Mr. Johnston, that the only time up to the date when Mr. Martin and Mr. Wetzler were discharged that either of them had an opportunity to examine the books was at about the 20th day of February, when you told Mr. Wetzler that he could look at the books? A. It probably was.

Counsel himself by his question just above admitted that the first demand that was made was at the board meeting when Mr. Johnston told them to examine the books and find out for themselves. And now the counsel admits by his last question that on or about Feb. 20, which must have been immediately before or after the board meeting at which he says the first request was made, Mr. Wetzler was, with Mr. Johnston's knowledge and approval, "looking at the books." It will be remembered that in the very early part of Mr. Martin's cross-examination he could not recollect that on March 5 Mr. Wetzler, with the aid of an accountant, was examining the books, but Mr. Martin did finally, after a little persistent effort on the part of the company's lawyer, and after the referee had reminded him that on that occasion "a letter of very peculiar import was delivered to him," recall this fact and admit it. This examination, if we are correct, was made some hours before they were discharged, and, if Mr. Martin is correct, at least two days before.

The reader will recall that there was some variance between Mr. Martin's and Mr. Johnston's testimony as to some of the important incidents in connection with this examination made on March 5, but very little variance between Mr. Johnston and the witnesses Foote, Stump or Colvin. Neither Foote, Stump or Colvin was asked a single question by Mr. Martin's lawyer as to whether or not Mr. Johnston attempted in any way to obstruct or interfere with that examination, yet Mr. Martin needed some support on that subject. But more than that, Mr. Martin omitted to bring forward the accountant, who was making the examination for Wetzler, as a witness. Why? He certainly could have told something about the books and this examination, and likely Mr. Martin knew just what he could tell.

The company was just one year in existence, and this was the first and only balance sheet; and although all the stockholders were members of the board of directors, not one of them ever proposed that that body, which had exclusively the power to do so, should declare a dividend, or in any other way correctly ascertain what the net earnings of the company were.

This "statement question" or "book examination question" was the biggest humbug in Mr. Martin's case.

So long as he thought he stood a chance of succeeding in his scheme founded on the letter of June 7 these grievances were not heard of, but when the referee intimated that that letter would not accomplish the work, "the statement question" and "the book examination question" came very largely to the front. Not until then.

Q. Now, at the time during the month of February weren't negotiations pending between you and Mr. John Henry Hull, a lawyer, and Messrs. Martin and Wetzler for the purchase of their stock? A. I think there were.

Q. And isn't it a fact that they objected to naming a price for the stock until they had an opportunity of examining the books and finding out the condition of the business? A. I don't think they gave any such reason. They did name a price for the stock.

Q. But do you know that such negotiations were pending. A. Well, there were no negotiations particularly.

Q. Either there were negotiations or there were not? A. I don't think you would call them negotiations.

Q. As far as you were concerned, were there negotiations pending, or were there not? A. I should say there were not.

Q. Had you authorized during the month of February, at any time, Mr. Hull to treat with Mr. Martin and Mr. Wetzler with regard to the purchase of their stock? A. I probably had.

Counsel returns to this subject later on, and we shall then make a comment.

Q. Now, you spoke the other day of a meeting of the board on Feb. 5, at which a resolution was introduced in regard to closing the stock book; what did I understand you to say that the bearing of that resolution was on the relations between you and Mr. Martin? A. The idea Mr. Martin had, or expressed, was that he did not wish anybody else—directors—elected who would take his place. There were only five directors, and he didn't wish anybody else put in who would take his place.

We have already pointed out what apparently was Mr. Martin's motives in this move. Mr. Martin was beginning to feel that his tenure of office was insecure. He was beginning to throw up fortifications; his foresight was always fairly good.

Q. And the point was, was it not, that in order to make the election regular under the by-laws the transfer book should have been closed before the election? A. That was it.

The trouble with this question is, that there was no such provision in the by-laws as is here assumed.

I never told Mr. Martin that while he was in the employ of the company he should remain one of its officers. I don't remember having told him that. I don't remember having told Mr. Stump that. Prior to this I had not been endeavoring to get Mr. Martin to resign.

Q. Had you made any efforts during the year 1890 to persuade Mr. Martin to resign as editor of the paper? A. After this episode in regard to the issue of Feb. 15 I asked him when I got back from Kansas City what he meant, and whether it would not be better for him to sell out his stock and leave peaceably.

Q. That was the first effort you made in any way toward securing his resignation? A. So far as I recollect. Mr. Stump and I had a conversation; Mr. Stump said that Mr. Martin was a fool, and that it was too bad that he had acted as he had. He said: "Mr. Martin is a very good man; he has done very good work for us——"

Q. (Counsel interposing). All I want to know is, when was the first effort made? A. It was on the day we came back from Kansas City, so far as I recollect.

Q. That was the first time that you took any steps or had any idea of having Mr. Martin resign? A. I don't recollect before that of any, although I had probably come to the conclusion before that some time he would have to go.

Q. Had you authorized Mr. Hull to secure his resignation for you in consideration of your purchasing the stock? A. I think not until after the issue of the 15th.

Q. Then until this Feb. 8 you were not trying to get rid of Mr. Martin, were you? A. Not that I recollect. I was hoping that he would——

Q. (Counsel interposing.) Were you taking any steps whatever to get him out of your paper prior to the occurrences of Feb. 8? A. Not that I recollect.

The counsel must have been of the opinion that it was somewhat important to Mr. Martin to make it appear that Mr. Johnston tried to get him to resign before the occurrences of Feb. 8. Such was not made to appear, however, and we are justified in assuming, on the importance attached to this by counsel, and the fact that Martin

did not take the stand and contradict Mr. Johnston on this point, that it could not be made to appear.

We said at the commencement of this report that we joined in this litigation only when no other recourse was open to us. Does not this undisputed testimony prove it? After the occurrence of Feb. 8 Mr. Johnston wanted Mr. Martin to sell his stock and leave peaceably. This could only be accomplished by paying Mr. Martin's modest demand of some $22,000, and paying it very promptly, otherwise he "should expect and ask better terms." We then thought that was an unwise course for Mr. Martin to take, and that by doing so he was not living up to the letter or the spirit of his contract. He no doubt thought otherwise, but it may be he has since changed his mind.

Q. And all your efforts were in the direction of peace and harmony, were they? A. Yes, if possible. Mr. Martin acted as if it didn't make a particle of difference whether school kept or not. He didn't seem to care whether he pleased me or not. He always tried to impress me with the fact that he could go to San Francisco and start an electrical paper, and that he was an indispensable man. He said he thought Mr. Wetzler's place could not be filled in this country, and he knew his could not. I think he said that in November, 1889. I put no obstacle in his way of remaining until after February. I found Mr. Martin more difficult to get along with than most of my employees. We have about fifteen to twenty employees in the office. The letters which Mr. Knight wrote were not written to journalists, and were not on the subject of obtaining somebody to act as editor.

I think I said I saw a statement in writing made by Mr. Kornfeld. I don't think either Mr. Newman or Mr. Weithas made any statement in writing. No statement, as far as I know, was submitted to either of them. After I returned from the Kansas City convention I caused Mr. Martin's and Mr. Wetzler's names to be removed from the editorial page as editors. This was done before the discharge, but while we were trying to fill their places. Even prior to that some changes were made in the office stationery. Mr. Martin's and Mr. Wetzler's names came off, and my own came off at the same time. All the names on it were taken off.

It was our custom in the office to take note of everybody's time except mine. Mr. Martin's time was not taken until after Feb. 8. It is not a fact that about the same time my coachman came down and sat in front of Mr. Martin's private office. Neither is it a fact that my footman came down and so sat. I never instructed Mr. Kornfeld to keep a personal surveillance of Mr. Martin, except in a general way. I asked him to do certain things for me. It is not a fact that I issued directions to Messrs. Martin and Wetzler that they should not receive visitors during office hours; nor is it a fact that I issued orders to them that they should not take more than half an hour for luncheon, but there was some talk about it after Feb. 8, probably with themselves. I asked them to come down at regular hours, the same as the other employees did. I asked Mr. Martin on one occasion to get the paper to press so that I could see the proofs at a certain time. That was for the issue of Feb. 22. I think that was the only occasion. These instructions were issued so that I should see the proofs in the afternoon, instead of waiting for them late at night. I had then lost confidence in Mr. Martin, and felt that I couldn't trust him. Prior to Feb. 8 there were absolutely no steps taken by Mr. Hull, at my direction, looking, toward securing Mr. Martin's resignation or the surrender of his stock; on the contrary, our effort was to keep Mr. Martin. As to Mr. Martin's efforts to draw away employees of The Electrical World, I know that certain persons came from the office in which Mr. Martin is employed, and said in a general way that they had a very nice office, and that people were treated very much better than they were by us; and if they felt like going down there to get better positions they would be very glad to see them. I know that some of them actually did go down, and word came to me in a roundabout way that they had gone. I know Mr. Martin asked one employee if she was not dissatisfied with her position. She has not left our employment. As to Mr. Hunt, if I were to answer according to my opinion, I should say both Mr. Hunt and Mr. Stump were influenced, more or less at least, by Mr. Martin.

Of what importance was it whether Mr. Johnston knew of Mr. Martin's efforts to take away the employees or not? Mr. Martin admitted it was so, whether Mr. Johnston knew of it or not. If it was done secretly, so that Mr. Johnston did not know of it—was concealed from him—it was all the less creditable to Mr. Martin.

As to the complaints which were made to me about Mr. Martin, I can only recollect that of Mr. Stump. That was made, I think, just after the meeting of the board of directors, at which Mr. Stump refused to act as Mr. Martin wanted. Mr. Stump said I must not give him any business to do with Mr. Martin, as Mr. Martin would not speak to him, and I had better do it through Colvin.

RE DIRECT EXAMINATION BY MR. KEIGHARN:

During the period at which Mr. Martin refused to speak to me in the office he never made any complaints to me of any harsh treatment on my part toward him. He never made any explanation of his conduct. He never found any fault of any kind. On Feb. 8 the first intimation I had of any delay in issuing the paper was from Mr. Kornfeld at about 4:30 p. m. When I spoke to Mr. Kornfeld that day my anxiety was lest the pressroom might close at noon, as it usually did on Saturday. From my knowledge of the manner in which I found the paper on Feb. 8, and from my knowledge and experience as an editor, Mr. Martin could have put the paper to press that evening had he remained. When I spoke of Mr. Martin in my cross-examination as being a capable man, I meant simply that he had the capacity for doing good work. I didn't mean that I, at that time, thought he was faithful to me or to the interests of the company. I simply meant that he had ability to do his editorial work.

In reference to the Kansas City convention, the men who reported it were those employed by Mr. Martin, and the report furnished was the work of those men whom he employed. As a matter of fact, there was very little editing done by either Mr. Martin or Mr. Wetzler when I removed it out of their hands. They had to make some few minor changes, but the entire work that they put upon it—the time necessary to make the changes that they have made in the matter—was really not very much. They could very easily have had all the matter that I sent them in the hands of the printer when I got home on Monday. I think about half the report had been put in the hands of the printer when I removed it from Martin's and Wetzler's hands. The work they had done on that consisted in running a pencil through a line or possibly a paragraph. That would not have necessitated anything more than merely reading the report, and not more than just skimming it over. The matter which I took away from them I turned in to the printer before I went to luncheon. I don't remember about how many pages there were of it. Before I took it away Mr. Martin had locked it up in his desk. I told him the printers were waiting for copy, and that it was very necessary that the matter should be in their hands at the earliest possible moment, and I was trying to hurry it. He said he was going out to lunch, and would attend to it when he came back. He did not offer to remain and finish it. I took it from him at about half past twelve and finished it in about an hour and a half; he could have finished it, I think, in about an hour and a half. The printers were in need of copy when I asked them to finish it. It was an unusually large number of the paper, the largest we had issued, and it was very important we should go to press as soon as possible. At the time I had an interview with a gentleman in London it was not with the intention of employing any one to fill Mr. Martin's position. I never gave instructions to have letters of Mr. Martin or Mr. Wetzler opened, but gave instructions to have letters addressed to myself opened. There were never any letters in the office addressed to them opened by others than themselves, to my knowledge. When I was asked about what motive Mr. Martin could have had for delaying the papers on Feb. 8, and said vindictiveness, I meant that Mr. Martin felt vindictive because he had apparently had the impression that he was a partner in the business; and that, no matter what he did, he could not be discharged. When he found that I had the right to discharge him, or any of the other men who held stock, as he did, he became exceedingly dissatisfied with his position, and did not seem to pay any attention to doing his work in such a manner as to meet with my approbation. That was the time that he would not speak to me in the office. He always took the ground that I could not discharge him. It is the custom with all editors to work more or less on holidays or Sundays. I don't think Mr. Martin, as a general thing, worked either Sundays or holidays. There wasn't any necessity for his doing so. The reason I gave no attention to the editorial business prior to Feb. 8 was because I was paying Mr. Martin for doing that work, and I let the responsibility of issuing the paper at the proper time rest on him. In reference to the letters which I gave Mr. Colvin when I was leaving for Kansas City, the reason I gave it to him was because, in view of Mr. Martin's treachery on the night before, I was afraid to trust him with the paper in any way, shape or manner, unless some one was over him to watch him; and I did not know as a matter of fact that Mr. Martin would come back to the office at all, or, if he did, what he might do if he had the chance of handling the paper in my absence. I had given instructions to the foreman of the printing office, Mr. Newman, on Saturday that, under no circumstances, should Mr .Martin or Mr. Wetzler be allowed to touch the paper. In talking over the matter with Mr. Colvin, we did not wish the paper to go out without editorials and in this incomplete form, so I said: "If you can induce Martin and Wetzler to write editorials and get the paper to press on Monday, as usual, I will give you authority to do so. If they don't care to do it, and you cannot get the editorials written, let the paper go as it is." In other words, I qualified the instructions I had given to Mr. Newman, so that Colvin could have Martin's assistance, if he could persuade him to put the paper to press in a more complete form. At that time Mr. Colvin was the most available man in the office. All the rest were absent, and Mr. Martin and Mr. Wetzler were uncertain. I never prevented Mr. Martin from obtaining information as to the finances of the W. J. Johnston Company, as long as he did not undertake to do it in the time for which he was paid. I don't know that I even prevented him then. When he asked me to furnish him with a statement, I said I would think the matter over, and possibly a report would be made at the annual meeting. The reason I didn't comply with Mr. Martin's request for a statement was that the system of bookkeeping in our office, while it is correct, is not such as to show the actual net earnings of the business; we had no salaries to officers, and we had nothing at that time for bad debts. No regular report had ever been made for the company; there was simply a rather informal report made from time to time which gave me an idea of how the business was running. The company was in existence about a year at the time these demands were made. During all that time Mr. Martin had been a member of the board of directors. He never made any motion of any kind in the board to have the directors declare dividends. I do not wish to have you understand that the books were not correct. They were simply kept in a manner that gave an idea of how the business was running, without being, however, in a position upon which to base the net earnings of the company. There were intimations or threats at the time to insist upon paying dividends on the amount that the books would shows as the earnings of the company. That was the intention or intimation when the effort was made to have the books closed at a certain date; it was done with the view of having dividends declared, and also to prevent any one being elected to succeed Mr. Martin, Mr. Wetzler, or the others. You are correct in understanding that my reasons in refusing to give Mr. Martin a statement were that we could not furnish from the books, or rather from the data in the books, a statement showing what the correct earnings of the company were for the year 1889. My reason for refusing to furnish the report was that I did not wish to be bound by anything that I might furnish which was incorrect. I never prevented him from obtaining the information which he sought himself. He was paid during that year the amount of the dividends which were guaranteed under the agreement. From the accounts that was all he would have been entitled to if a dividend had been formally declared. I know that to be a fact. When he named the price for his stock it was in the neighborhood of $23,000. He tendered his services after he was discharged—probably the second day after he was discharged.

RE CROSS EXAMINATION BY MR. MASTEN.

On Feb. 8 I drew Mr. Kornfeld's attention to the fact that the press room closed at 12 o'clock on Saturday, and to make sure that it did not close until we got 500 copies run out. This was before noon. As to reporting the convention, the proposition came to the office saying the proceedings would be reported on certain terms. That was accepted by Mr. Martin on behalf of the office. He accepted it without consulting me. When I returned on Monday, the 17th, there was a great deal of matter that I had sent from Kansas City which should have been in the printer's hands. Instead it was in the editorial room, and while Mr. Martin claimed he was doing the very best he could, I knew from his actions he was doing as little work on the paper——

Q. (Counsel interposing.) I didn't ask you all that. Was there anything remaining to be done excepting the editing of the report sent on from Kansas City, and the editorial notes? A. That was about all there was in that issue of the paper. The paper issued comprehended about 32 pages, of which 29 were report, and the rest were editorial notes; those editorial notes ought to have been written on Friday and Saturday, and could have been just as well as not, at least most of them. The other matter ought to have been turned in, as it was turned in from me; instead of that it was allowed to accumulate. It is a fact that the greater part of the matter consisted of papers read at the convention which had been put in type during the preceding week while I was absent. It is also a fact that the matter which was not in type consisted of stenographic reports of the discussions on those papers. I have no means of knowing whether two-thirds of that did not arrive at the editorial department until Monday morning. I know when I mailed it from Kansas City. It should have reached the editorial department much earlier than that. The editorial notes which I, or others at my request, had composed were composed after we had all the matter in type and found we had no editorials ready; we were in the same condition in relation to the editorials that we were the week before—Mr. Martin had failed to write them.

Q. Did you understand that I asked you any questions with regard to whether or not any letters of Mr. Martin's or Mr. Wetzler's were opened in your business office? A. I understood that some insinuations were made.

Q. Did you understand that I asked you any questions upon that point? A. I don't know whether you asked the question, or whether Mr. Martin simply answered, but I thought there was an implication that Mr. Martin's personal mail was opened in the office. My own letters were opened, but not Mr. Martin's.

Q. You didn't understand that there was any testimony in this case on that point? A. I thought that there was an intimation on that point.

The witness thought some insinuations were made, and was entirely correct in his thinking. But like all the rest, it was only an insinuation. One of Mr. Martin's wails, quoting his own words, was: "Mr. Johnston had taken all power away from me, and withheld even my own personal letters, let alone the office letters."

His lawyer, we suppose, forgot all about what he said. If he did not forget it, then the last three questions were put for some purpose, and we suspect that that purpose was—not a very manly one—of striving to make it appear that Mr. Johnston volunteered the statement that he did not open Mr. Martin's mail, not because he was accused, but because he was conscious of having done so.

This as a last assault on Mr. Johnston in Mr. Martin's behalf was quite in keeping with all that preceded it.

When I testified at the last hearing that I never prevented Mr. Martin from obtaining information as to the finances as long as he did not undertake to do it in the time for which he was paid, I meant that I didn't think that Mr. Martin, drawing salary as editor, had a right to use the time due to the company for the purpose of making an examination of the books. He could have given a power of attorney to some one else to examine them. I never objected to his giving a power of attorney on the ground that the examination must be made by him personally. I don't think I made any opposition during the year 1890 to stockholders getting at the condition of the company's affairs. On the occasion of the annual meeting Mr. Martin made a request of that kind, but on no other occasion. After his discharge I think he did. I think I conferred with Mr. John Henry Hull with regard to Mr. Martin's relations to the company during the year 1890. I never opened negotiations through Mr. Hull to secure Mr. Martin's resignation and to purchase his stock until after the issue of Feb. 15—after Mr. Martin failed in his duty. I feel very positive that no efforts were set on foot looking toward the purchase of Mr. Martin's stock or securing his resignation prior to the 15th of February.

Q. When such negotiations were on foot, be it before or after Feb. 15, is it not the fact that Mr. Martin made application to you to be allowed to examine the books for the purpose of posting himself as to the value that he ought to ask for his stock? A. I don't recollect that he did.

RE-DIRECT EXAMINATION BY MR. KEIGHARN.

It was a matter of very great importance to the interests of the W. J. Johnston Company to get the paper containing the convention report to press as soon as possible, because it was the most important number in six months, and the promptness and accuracy of the report gave us a great deal of prestige in the business. There was a great deal of rivalry as to who should have it first before the public.

TESTIMONY ON BEHALF OF PLAINTIFF IN REBUTTAL.

Joseph Wetzler, examined by Mr. Masten:

I am the individual referred to in this case several times. I first became connected with The Electrical World in 1883, and I left it at or about the time Mr. Martin did, in March, 1890. I recollect Saturday, Feb. 8, 1890. I was working on the paper all day, and I was in the room with Mr. Martin. The effect of going to

press ahead of time would naturally be to have everything rushed; everybody would be as busy as they possibly could be. I recollect on this day when Mr. Johnston came over to the printing office. I saw him converse with Mr. Martin; I can't say that I heard what was going on. He was between 20 and 30 feet away from me. I saw Mr. Johnston walking about the stone with proofs in his hand, giving directions to Mr. Weithas, and Mr. Martin speaking to him, addressing him and following him about, but Mr. Johnston apparently paying no attention to what Mr. Martin was saying. He had his back turned on Mr. Martin. Mr. Johnston did not address any remarks to me that I recall.

If what Mr. Wetzler says about the paper going to press earlier was the excuse for their failure to get it to press, why did they not think of and stand upon that at the very outset, instead of suggesting it for the first time at the end of the case.

Mr. Wetzler could not hear what was going on though only 20 or 30 feet away. He evidently did not observe what Mr. Martin said he saw so plainly—that Mr. Johnston was wild and angry.

It is worth remembering here that Mr. Weithas said he was not present on the occasion referred to. Yet Mr. Wetzler says Mr. Johnston was giving him directions. Mr. Martin said it was to Mr. Newman that Mr. Johnston was giving directions. They find it hard to agree.

Q. Did you hear him ask Mr. Martin whether he was going to stay and make up the paper, or if he would stay and make up the paper? A. I did not.

Q. Did he make any such request of you? A. No, sir; I don't recall his addressing one single word to me.

In connection with these questions it is worth recalling the counsel's question to the witness Kornfeld, viz.:

Q. Are you sure that it was not Mr. Wetzler that Mr. Jonnston asked to stay after five o'clock? A. I am not.

Mr. Martin came over and told me——

Counsel for defendants objects.

We consulted together, and came to the conclusion——

Counsel for defendants objects.

We consulted together and after a short time left the printing office together.

Q. What was the condition of the paper, so far as the make up went, at the time that you left? A. The paper was very far advanced. There were, I believe, over 16 pages made up, out of an issue of 18 or 20 pages, which it was intended to be; so that in a very short time—probably two or three hours—it could have been finished if we had not been interfered with.

Q. Had you at the time when you left the office done any work of writing editorials or editorial notes? A. To the best of my recollection, yes.

Mr. Wetzler was more careful about this than Mr. Martin. He answered this: "To the best of my recollection." Mr. Martin was positive on the same subject. He said he had his own editorials all ready. "There were some of Mr. Wetzler's I had not."

Q. You remember the fact that another edition of the paper was put to press on Monday? A. I do. Mr. Martin and myself arrived at the printing office about eight or half-past eight on Monday, and found the forms had not come back from the press room. And they did not get back until 12 or thereabouts; and then we immediately set about to make the paper in the way we had originally intended to do, and put it to press. It went down that night again about four or five.

Mr. Martin said: "I got the paper to press on that Monday by midday; very swiftly. I got it out from the press early that afternoon, and it was sent to Kansas City early in the afternoon of Monday, by my orders."

Q. When were the editorial notes that were used in that edition turned in? A. Some of them were turned in on Saturday night, and some on Monday morning. I did not see Mr. Colvin between the time I left on Saturday and Monday morning. I don't think I saw Mr. Martin on Sunday. I was busy.

Q. Do you recollect the circumstances attending the issue of the following week, the paper bearing date Feb. 22? A. I do—pretty well. The first part of the stenographer's report of the Kansas City Convention got to the office on Saturday, the 15th, and the remainder a little late on Monday morning, the 17th.

Q. What was Mr. Martin's standing professionally, and as an electrician, during the time that he was connected with The Electrical World?

Objected to. Objection sustained.

CROSS-EXAMINATION BY MR. KEIGHARN:

Q. In reference to the issue of the paper of Feb. 15, I understood you to say that on that Saturday, Feb. 8, you prepared quite a number of articles? A. No; I did not say so; I prepared some.

Q. How many? A. I can't give you the exact number.

Q. Can you by referring to the paper specify any articles written by you which were prepared on Saturday? A. I don't know whether I could. I know I was busy all day, either preparing articles or reading proof.

Q. Do you wish to examine the paper? A. Yes. My memory probably would not serve me on that particular thing. (After examining the paper) No; I don't think I could identify any particular article that I prepared on that day.

Q. After examining the issue of Feb. 15, you cannot specify any of the articles referred to in the direct examination as prepared by you on Feb. 8? A. No, sir.

Q. You stated in response to Mr. Matsen, that a large part of the matter which you were to use in the paper on that Saturday morning arrived late? A. Yes.

Q. Are you able to specify what that matter was? A. I don't know that I could point out the particular items, but I do know that some matter came in late on that Saturday morning.

Q. Do you wish before answering my question finally to refer to the paper and point out what you say came in late? A. I don't think it would be any aid. I know in late? A. I don't think it would be of any aid. I know the matter was late that morning. I should say Mr. Martin's department, so that probably I would not be able to point it out. It was not purely technical matter.

Q. How do you know that it was late? A. Because I know Mr. Martin was telephoning all the morning over to the office, to hurry the matter over.

Q. How often do you suppose he telephoned that day? A. He must have telephoned two dozen times.

Q. What did you wish me to understand you to mean when you used the expression that you were the "technical editor of the paper"? A. I meant that all matter pertaining to theoretical or practical applications of electricity were under my charge. All matters that merely pertained to the news of the day, or small items, were not my business.

Q. Am I to understand in connection with that that you are an electrician? A. Yes.

Q. Mr. Martin is not? A. He is not professedly an electrician. I would rather say I am an electrical engineer; it is a better term.

Q. Where a matter pertaining to electricity was to be treated it would be turned over to you, would it? A. As a rule, yes. By that I do not mean that Mr. Martin was, or is, incompetent to handle those subjects; but it was the custom to hand them over to me.

Q. Can you point out to me in the paper what technical articles you prepared on that day, Feb. 8? A. I believe you already asked me the same, or a similar question, on a previous hearing, and that I was unable to point out any specific article.

Q. I asked you the articles generally. Now, can you point out the technical articles that you prepared that day? A. If you will hand me the paper, I will try to identify those written that day. I will repeat that I believe I was unable then, and probably would be unable now, to identify any specific article. I don't believe there is any use of my looking through it. I don't think I could identify any article prepared in that paper now.

Q. Were there times that Mr. Martin issued the paper without any aid from you? A. Yes.

Q. Was there any time that you issued the paper without aid from Mr. Martin? A. Yes; I believe on one or two occasions when he was off in the country.

Q. Then, either one of you was competent to issue the paper in the absence of the other? A. Yes, for a short while. I wouldn't care to do it every time, I assure you.

Q. I notice in your testimony that you said on that day Mr. Martin telephoned over to the office at least two dozen times. Now, was that answer correct? A. Yes, as far as my knowledge goes. Yes, or I should not have said so.

Q. Suppose that Mr. Colvin had said that he telephoned three times on that day, would you still adhere to your answer that he had telephoned at least two dozen times? A. Yes.

Q. Mr. Johnston, you said, held no conversation of any kind with you in the printer's office on Feb. 8? A. That is what I said. That is correct.

Q. Did you address any questions to Mr. Johnston? A. I don't remember having addressed any question to him.

Q. You knew on that 8th of Feb. that it was important to get that paper out before you left there? A. I knew that it was important to get the paper out.

Q. You knew that if it was not got out that night it could not be sent the following morning to Kansas City? A. That follows, as a matter of course.

Q. I ask you if you did not know it? A. Well, yes, I must have known it; if the paper did not get out that night it could not go the next day.

Q. When you left that office on that Saturday night had you permission from Mr. Johnston to leave there?

Objected to. Objection overruled.

A. I have already testified that I had addressed no words to Mr. Johnston, and that Mr. Johnston addressed no word to me.

Q. Now, answer my question, yes or no?

The Referee: That is a sufficient answer, Mr. Keigharn; nothing passed between them.

Q. Did you ask Mr. Johnston whether you might leave there? A. I think that is implied, is it not, from my previous answer?

The Referee: I think so, Mr. Keigharn; the witness says nothing passed between them. He wanted to go, and he went.

Q. When you left there on that evening you had no knowledge that the paper would have been got to press by Mr. Johnston in your absence? A. I couldn't know what was going to happen after I left.

Q. So far as you know, when you and Mr. Martin went away the paper was not to go to press that evening? A. I know nothing of the sort. I don't think you have got my answer right. I may not have expressed myself correctly. What I meant to say was this: Of course, we could have no knowledge of what happened after we left.

(Question repeated.) A. I don't know anything about that.

Q. Were the editorials that appeared in the paper on Monday, written Monday morning, when you came there? A. No, sir. I wrote some on Saturday and some on Sunday, as near as I can remember.

Q. When did you hand them in to the printers? A. I handed them to Mr. Martin.

Q. Can you tell me how many of them you handed in to Mr. Martin, as you claim, on Saturday, before you went away? A. I can't tell now how many were handed in to him. I don't remember.

Q. How long, ordinarily, would it take you to write these six editorial notes? A. The mere writing of them probably would not take very long, when I got down to them.

Q. I mean composing them? A. It might take me three hours sometimes, to write a column of editorials, because I had to go over the thing and see what the salient features of a paper were.

Q. When you went away from there on Saturday did you go at Mr. Martin's request?

Objected to. Objection overruled.

A. I don't recall whether I did at his request or not.

Q. After Mr. Johnston removed the matter, you and Mr. Martin went out to lunch, didn't you? A. Yes, I guess so.

Q. How long did you remain? A. I don't remember.

Q. How late in the afternoon was it on that day that you offered to resume your work on the report? A. I never offered to resume any work on the report, I don't believe. I went in to Mr. Johnston and asked to be allowed to continue my work.

Q. At what hour of the day was it you offered to continue your work? A. I don't know; may be three or four o'clock. Some time during the afternoon.

Q. What had you been engaged on from the time you went out to lunch at half past 12 to 3 or 4 o'clock? A. I don't remember.

Q. Hadn't you been away from the office all the time? A. I don't know.

Q. Are you willing to swear to that? A. Yes. When I say I don't remember, I don't know.

Q. Did Mr. Martin offer to go with you when you offered to resume work on the report? A. Yes.

Q. It was then that Mr. Johnston said to you, as you say, that he certainly would not allow you? A. He said: "I certainly would not leave it to you."

Q. Did he make any reference at all to your failure on the previous week? A. I don't remember that he referred to the matter.

Q. Was there anything said between you and him, or between Martin and him, in your presence, as to your having already failed in putting the paper to press? A. I don't recall it.

Q. Were not these the words that Mr. Johnston used: "I certainly wouldn't trust you with it"? A. Not as near as I can remember.

Q. Are you sure? A. I am pretty sure he didn't say "trust." He said: "I certainly wouldn't leave it to you." Those words impressed themselves on my mind at the time.

Q. Before Mr. Johnston came in there, wasn't it your intention or wasn't it arranged between you and Mr. Martin to leave there at five o'clock?

Objected to. Objection overruled.

A. No, I think not.

Q. Did you know when Mr. Johnston came there that Mr. Martin wanted instructions as to something? A. I don't remember anything of that sort.

Q. When Mr. Johnston was going about the stones, did he take the proofs in his hands? A. Yes, the galley proofs.

Q. He didn't have all the proofs in his hand? A. It is not likely. He took up one galley after another.

Q. The fact that he happened to take some part of the proofs in his hands would not in any way prevent you from performing your work upon them, would it? A. We had finished with the galley proofs entirely.

Q. Can't you answer my question, whether or not the mere fact that Mr. Johnston took some part of these proofs into his hands would prevent you from performing whatever work you had to do on the paper? A. Yes.

Q. You swear it would? A. Yes.

Q. Why would it? A. Because when one man has the proofs, and orders the printer to make up the paper, and calls for those proofs, there couldn't be anything done.

There is not in the whole case a greater shift or evasion than is shown here.

Admitting that Mr. Johnston was handling or inspecting the galley proofs, and taking all that Mr. Wetzler has just said as true, what was there in Mr. Johnston's actions to constitute interference. Wetzler himself saw the nonsense of this claim, and then he shifted again.

He was asked why would the fact that Mr. Johnston was handling the proofs interfere. He answers, "Because when one man has the proofs in his hands and orders the printer to make up the paper, and calls for those proofs, there couldn't be anything done."

And then to cap the climax of absurdity he admits that he neither saw nor heard Mr. Johnston order the printers to make up the paper, but inferred this to be so because nearly 48 hours afterward hearing the paper had been made up he knew some one must have ordered the printers to make it up.

A little further on he confesses with great frankness, but after some little fencing to avoid making the confession: "I do not now recall any direct interference by Mr. Johnston with my work on that day."

Notwithstanding this, he would not tell why he quit his work. "He thought" he was not asked to do so by Mr. Martin. If this was correct it must have been out of sympathy with him or else by some mutual understanding—no doubt the understanding which existed between them when the company was organized lasted to the end—till their connection with it was dissolved—and probably beyond even that time.

Q. Do you mean to say that Mr. Johnston ordered the printer to make up the paper in your presence? Do you know of your own knowledge whether Mr. Johnston ordered the printer to make up the paper? A. I didn't hear Mr. Johnston order the printer to make up the paper. I didn't hear him order anybody.

Q. Do you know that he did? A. Yes. Because the man wouldn't have done it if he hadn't been ordered. ordered.

Q. Is that the only way you know it? A. Yes.

Q. Why didn't you write the editorials you wrote on Sunday in the printing office after Mr. Johnston came there?

Objected to. Objection overruled.

A. Because Mr. Johnston, having taken the whole matter in his hands, allowing no interference by Mr. Martin, I came to the conclusion that he would allow no interference by me; and I came to the conclusion that it was useless to stay there longer.

Q. When you say Mr. Johnston took the whole matter in his own hands, can you tell me any specific act which he did more than you have told me? A. I don't know what you refer to particularly by "specific acts."

Q. I want you to tell me specifically what he did which interfered with you; I don't want you to characterize it as interference. Tell me what he did?

Objected to. Objection overruled.

A. As I previously testified, Mr. Johnston addressed nothing to me on that day. He refused to answer the questions addressed to him by Mr. Martin. I do not now recall any direct interference by Mr. Johnston with my work on that day.

Q. Now, in view of the fact that you cannot recall any interference by Mr. Johnston with you, can you tell me why you did not remain there and write the editorials?

A. I answered that question, I think, a short time back.

Q. You placed your answer on the ground of interference. Now it appears that there was no interference, as far as you can recall, and I ask you, can you explain why you did not remain and write your editorials? A. I think my former answer will answer it. I can answer the question by repeating what I said before.

Q. And you can't give any other answer? A. No, sir. I prefer to repeat the answer.

Q. When Mr. Johnston came into your office and took away that Kansas City report, can you remember what Mr. Johnston said to Mr. Martin in your presence? A. I think he said he wanted the report.

Q. He just simply said he wanted the report, and you and Mr. Martin gave it up? A. Not without a protest.

Q. Now, what was the ground of your protest? A. The protest was that we had not finished it, and ought to be allowed to finish it before it was sent in to the printer. That is what we were being paid for.

Q. That occurred about half-past 12? A. Somewhere about that time.

Q. You knew at that time that Mr. Johnston was trying to rush things, to have the paper go to press? A. I didn't know what Mr. Johnston's ideas were; he didn't converse with me on the subject.

Q. Would you, as one of the editors of the paper, regard it as important that things should be rushed and the paper put to press? A. Yes, most decidedly.

Q. You knew, as a matter of fact, that it was important? A. Very, and acted accordingly.

Q. When you saw Mr. Johnston in the afternoon, you then said to him that you were ready and willing to do the work on the paper? A. Yes.

Q. And that was about five o'clock? A. Somewhere, yes.

Q. Now, knowing that it was important to rush that matter, why didn't you offer yourself as ready and willing before five o'clock?

Objected to as irrelevant and immaterial. Sustained.

RE-DIRECT EXAMINATION BY MR. MASTEN.

Q. Do you recollect whether or not the editorial matter which came to the editorial department for the convention number came from the business office, or to you or Mr. Martin directly? A. From the business office.

This was threshing out the old material with a vengeance. Mr. Martin went all over the same ground.

The point sought to be made by this threshing process is that the mails from Kansas City were delayed all that week, because the report came on different days, and a delay on one day would not explain how it all failed to reach them. Or else the "business department," which is only another name for their friend Mr. Colvin, deliberately withheld this report from them.

As we pointed out before, all likelihood of the mails having been delayed is removed by the failure of Mr. Martin to produce Mr. Colvin to say such was the fact.

All likelihood of Colvin having withheld the report from them is removed by Mr. Martin's spirited epistle written on this occasion to Mr. Colvin, when he told him that he was the "vice-president," "vested with all powers in the absence of the president," and that he, Colvin, must submit everything to him, "including the disposal of all correspondence," and would be held "strictly responsible for carrying out these explicit orders."

As this comedy of a lawsuit draws to an end it degenerates into a downright farce.

WILLIAM J. JOHNSTON, recalled for further cross-examination by counsel for plaintiff, testified as follows:

BY COUNSEL FOR PLAINTIFF.

Mr. Masten: Did you at any other time assign any reason for the discharge of Mr. Martin? A. I don't think he asked me for any reason, and I volunteered no information that I can remember.

Q. Did you, voluntarily or involuntarily, spontaneously or otherwise, ever state to him the reason why he was discharged? A. I don't remember that I ever did.

Q. Isn't it the fact that he was discharged by you, not because of any specific violations of duty, but because you considered the differences between you irreconcilable? A. No, sir.

Q. Haven't you ever stated that the reason for Mr. Martin's discharge was a hopeless difference of opinion between you and him? A. I may have stated that it would be better to let the matter go as an irreconcilable difference of opinion. I don't think I ever stated it as being such specifically. I simply made the matter easy for Mr. Martin to sell me his stock, and let the matter go as an irreconcilable difference of opinion.

Q. Haven't you ever stated that Mr. Martin was discharged simply because there was a hopeless difference of opinion between you, and that there was no way, as long as he wouldn't resign, but discharge him? A. No, sir; I did not. I may have said, though, that when the President and one of the cabinet officers has a difference which is irreconcilable, somebody has to resign, and that usually the President can't. That's the furthest I ever went.

Q. Do you know Mr. Shaw, who has been referred to here? A. Yes.

Q. Do you recollect having sent Mr. Shaw a letter of which that is a copy? A. I may have sent it, but I don't recollect it; or I may have asked some one to send it, and have signed my name to it.

The only part of that letter which has any bearing on this case is in these words:

"If anybody speaks to you about changes in this office please treat the matter as of no permanent moment. Just say that as you understand it differences of opinion arose which seemed to be irreconcilable. Of course, the only thing to be done was for some one to resign; and as I could not very well do anything of that kind, the others, having been given an opportunity of handing in their resignations, their services were dispensed with."

The defendants did not object to this copy, although they could have done so, and excluded it from the case because it was only a copy.

Mr. Johnston probably wrote that or something like it, and for that reason would not prevent them from using it, if they thought it of any advantage. But was it?

To the question, "Haven't you ever stated that Mr. Martin was discharged simply because there was a hopeless difference of opinion between you, and that there was no way, as long as he wouldn't resign, but discharge him?" (all the time this Shaw letter being concealed) Mr. Johnston answered: "I may have stated that it would be better to let the matter go as an irreconcilable difference of opinion."

The manly way would have been to have shown Mr. Johnston the letter at once, and then used it for all it was worth. But no; that was not what they wanted. They wanted something more than the letter contained, something which apparently had no existence as a fact. They wanted verbally to interpolate into Mr. Johnston's answer and make him admit that he spoke these words: "That there was no way, as long as he (Martin) would not resign, but discharge him." Mr. Johnston answered firmly: "No, sir; I did not," and there this attempt ended.

There was no effort to make good what the question implied, and the Shaw letter contains no such expression as they sought to get Mr. Johnston to admit he used.

We have said in what we have already written that Mr. Martin might have for some things shown some sense of gratitude. He ought to have shown such for this letter to Shaw. Had Mr. Johnston written to Mr. Shaw, who was then the representative of The Electrical World in Boston, many things which this case has disclosed, he would then have been accused of being spiteful and uncharitable.

Instead, he merely wrote to Mr. Shaw: "Just say that as you understand it differences of opinion arose which seemed to be irreconcilable," as he himself says, "to make the matter easy for Mr. Martin."

There was nothing discreditable in this, or inconsistent with the claim that Mr. Martin was discharged for misconduct and neglect of duty. Mr. Johnston did not say in this letter that Mr. Martin was discharged for "irreconcilable differences," but he instructed Shaw to just say that that was the way he understood it, and pass the thing over, making it as little disagreeable for Mr. Martin as possible.

True, Mr. Johnston said in the letter: "Of course, the only thing to be done was for some one to resign; and as I could not very well do anything of that kind, the others, having been given an opportunity of handing in their resignations, their services were dispensed with." But was not all that strictly true and strictly honest? What else could be done but to dispense with their services? Did Messrs. Martin and Wetzler seriously expect that Mr. Johnston should have resigned, because of their "irreconcilable differences"? Many things which occurred, as shown by the details of this case, would lead one to believe that that is what they were deluded enough to think ought to happen, or at least what they supposed they had the power to make happen. How they were mistaken in their calculations! Their differences were without doubt irreconcilable, and the only mistake Mr. Johnston made was that when they became so he did not then discharge them, and end their nonsense

We shall make no further comment; but leave the reader to form his own opinion of the use they sought to make of Mr. Johnston's letter to Mr. Shaw?

Counsel for Defendants: We have Mr. Colvin here this morning, and the question of allowing me to call him comes up here. I think the record shows that if he should happen to appear here before you, Your Honor said you would allow me to recall him. I now ask you to permit me to recall him for the purpose of cross-examining him.

Counsel for Plaintiff: If that is a motion, I will have to state that I was present at the last session in the corridor of the Equitable Building; and as I understood that Mr. Colvin was directed to appear by counsel for defendant, who paid him and subpoenaed him, I hardly think that it accords with Mr. Colvin's happening in here.

Counsel for Defendants: In answer to that, I state that I will call Mr. Colvin in accordance with the subpoena to testify to something that I believe he can establish for us; but before that I ask that I be permitted to recall him for the purpose of cross-examination.

The Referee: I hardly think that is regular.

Counsel for Plaintiff: *I object to the witness being called for cross-examination.*

THE REFEREE: Motion denied.

Richard L. Weithas, a witness on behalf of the defendant, recalled: I was examined in this case before. On the 8th of February, 1890, between a quarter before five and a quarter after I was receiving no instructions of any kind from Mr. Johnston in the printing office. At about five, it may have been a little before or a little after, I left the office. I came back about a quarter to six. When I came back Mr. Wetzler wasn't there. Between 5 and 5.45 I had no conversation with Mr. Johnston

This contradicts Mr. Wetzler where he swore that at the time Mr. Johnston was taking the proofs he was going around giving directions to Mr. Weithas.

This is the end, and we are as pleased to have reached this point as we are sure the editors of the "Electrical Engineer" would have been if there never had been a beginning. The reader knows the rest. The Court after considering Mr. Martin's case decided that he was in the wrong, and threw him out of court. As a result of years of plotting and planning he has certainly not accomplished what he had sought. THE ELECTRICAL WORLD has not been detrimentally affected by the action, while as a reward for his labors Mr. Martin has mortification and defeat and besides a bill of over $800 to pay as costs, for which the W. J. Johnston Company holds judgment against him. He has appealed from that judgment, and we await without the least anxiety the result of that appeal.

Before contemplating, much less putting into execution, any further efforts like these just brought to a close, Mr. Martin might do well to give heed to what Lord Lytton says on the subject of ambition: "Say what we will, you may be sure that ambition is an error; its wear and tear of heart are never recompensed; it steals away the freshness of life; it deadens its vivid and social enjoyments; it shuts our souls to our own youth, and we are old ere we remember that we have made a fever and a labor of our raciest years."

NEW BOOKS.

CONTINUOUS CURRENT DYNAMOS AND MOTORS: Their Theory, Design and Testing. With Sections on Indicator Diagrams, Properties of Saturated Steam, Belting Calculations, etc. An Elementary Treatise for Students. By Frank P. Cox, B. S. New York: The W. J. Johnston Company, Limited. 1893. 271 pages, 83 illustrations. Price $2.

This work, intended for students, gives the theory and design of continuous current dynamos and motors as understood and practiced in the designing room, and the methods of testing described are those of the factory testing room. The practical side of the various questions treated is always kept in view, discussions having little bearing in this direction being excluded, as well as the descriptions of different machines and systems which so often encumber and pad out the pages of similar treatises.

The first four chapters consist of a brief review of the electrical units and the general principles of the machines, and may be considered as an introduction to the subsequent portions; the higher branches of mathematics have been avoided here as elsewhere throughout the book. Chapter V. is on calculations pertaining to the magnetic circuit, in which the principles relating thereto are logically developed and concisely expressed. Chapter VI. treats of the theory of windings, losses, etc., and Chapter VII. of the special points to be observed in motor designing. In Chapters VIII., IX. and X. the application to the design of armatures, field magnets and motors of the principles developed in the preceding chapters is explained by reference to numerical problems selected so as to cover as broad a field as possible, and show in what manner to make the various compromises always necessary in practical designing. This is an admirable feature of the work and enables the student to perceive the exact bearing and relative importance of what he has learned in the first portion of the book. In Chapters XI. and XII. the methods of testing a completed machine and investigating its characteristics and the effect of various changes in design and operation are fully discussed and illustrated by numerous curves.

As the subject of the steam engine is one so closely allied to the testing and operation of dynamos and motors, the last two chapters are devoted to indicator diagrams and steam power calculations, which are treated in the same eminently practical manner as the purely electrical subjects. The four appendices are on tests of irons, ampère-turn tables, determinations of sizes of wire for armatures and field coils, and on the calculation of belting.

With two exceptions all of the engravings were specially prepared for this work, and almost all of the numerous curves are reproductions of those obtained in actual commerical tests.

ALTERNATING CURRENTS. An Analytical and Graphical Treatment for Students and Engineers. By Frederick Bedell, Ph. D., and Albert Cushing Crehore, Ph. D. Second edition. New York: The W. J. Johnston Co., Ltd. 1893. 325 pages, 112 illustrations. Price $2.50.

That a work of this character was greatly needed is evident from the fact that the first edition was exhausted in a few months. That it possesses great merit is shown by the numerous complimentary testimonials received by the authors from the highest authorities on the subject. As a complete and logical presentation of the subject in mathematical language easily followed by students and engineers, and also in graphical methods within the reach of those without a mathematical education, the work stands alone, and comes at an opportune moment as an assistant to those entering a branch of electricity which has commenced to monopolize the field of practice.

The authors have taken advantage of the opportunity afforded by a second edition to eliminate a few errors that crept into the first edition of the book and to make such minor changes as seem to render the explanations more clear.

Besides the appreciation shown in America the book has had a very flattering reception abroad in reviews, and is now being translated into French and German.

PRACTICAL DIRECTIONS FOR ELECTRIC GAS LIGHTING AND BELL FITTING FOR AMATEURS. By Edward Trevert. Paper covers, 50 pages, 28 illustrations. Price 25 cents.

This little pamphlet is a compilation from electrical supply dealers' catalogues, and the greater part of the text is devoted to descriptions of trade cuts. Electric bell fitting is disposed of in about a half-page description of some bell circuits, and a dozen pages on electric gas lighting are apparently extracted from the catalogue of a well known Boston electrical dealer.

A Model Central Station on the Pacific Coast.

In 1879, when the arc light was a new invention, at which people marveled, the California Electric Light Company was incorporated to operate some Wallace-Farmer electric machinery, but, unable to obtain satisfactory results with it, made an arrangement with the Brush Electric Company to operate their apparatus, and began the lighting of San Francisco from a central station, which was the first central station ever built in the United States. This was burnt down in 1880, but was immediately rebuilt. The customers increased rapidly; they had tried the new light and found that it was good, and the new station was enlarged in 1882, and again extended in 1885. In less than three years afterward, even this larger station became too small for the business, and in 1888 a new station was erected, which was at that time the largest in existence. This is still occupied and is known as station "B" In July, 1891, the Edison Light and Power Company was incorported, with Geo. H. Roe as president—the same man who, full of hope as to the future of electric lighting, had founded the California company. This company, with an authorized capital of $3,000,000, was formed to operate the Edison incandescent system, and to take over all the rights and franchises of the California Electric Light Company. By this consolidation both the arc and incandescent lighting systems of the city were brought under one head and at the present time the company controls not only the Edison and Brush rights, but also those of the Thomson-Houston, Fort Wayne, Excelsior and Schuyler companies, and holds the only franchises for overhead wires and poles and underground conduits for electric lighting and power ever granted in the city.

FIG. 1.—THE SWITCHBOARD.

The new company at once began the erection of still another station, and it was determined from the start to make this station absolutely modern in all its appointments, and no old machinery has found a place there. This station, known as station "C," was completed in 1892. It has a present capacity of 44,000 incandescent lights, and provision has been made for an ultimate capacity of 87,000 lights. It is located on Jessie street, adjoining station "A," the two having a total frontage of 300 feet. It is a substantial structure of brick and iron practically fireproof, and covers an area of about 14,000 square feet.

The boiler room is laid out for thirty 250-h. p. boilers, to work under a pressure of 165 pounds. Above the boilers are located the large iron coal storage bins. From these the coal is fed through chutes to hoppers, which feed the mechanical stokers. These, in turn, force the coal up into the furnace from beneath, and thus prevent the ingress of cold air to the boilers, while providing for the complete combustion of the gases, the coal being heated to a high degree before being actually burned in the furnace.

The engine room adjoining is about 80 feet square, with a ceiling 37 feet high. Around the walls runs a gallery at a height of about 14 feet from the floor. The foundations for the engines are of concrete 14 feet in depth, and the six cover an area of about 3,600 square feet. They have no connection with the building proper, but are entirely independent, and thus no jarring is noticeable in the station. The generating plant, Fig. 2, consists of four General Electric combination sets, i. e., two 100 kw. multipolar dynamos directly connected to an Edison triple expansion engine of marine type, and six 200 kw. multipolar dynamos, each pair of which is similarly connected. Four more 200 kw. machines will be put in later. The belted dynamo has no place in this station.

The switchboard, Fig. 1, in the gallery, is one of the largest and finest ever built. It is of solid marble, polished, 57 feet long and 9 feet high. This has already been described in The Electrical World of Jan. 7, 1893, before it left the factory for the West.

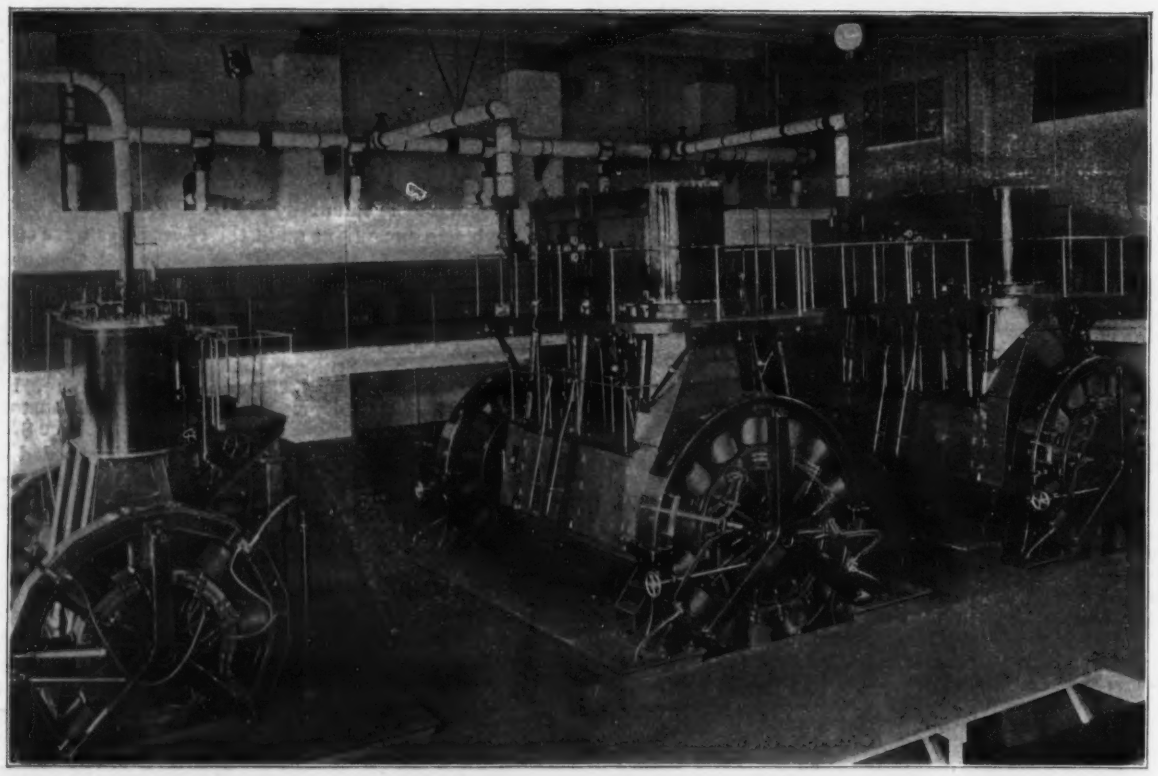


FIG. 2—INTERIOR VIEW OF STATION.

On the floor above the engine room are the offices of the chief engineer and chief electrician, the laboratory, meter room, draughting room and repair shop. The laboratory is fitted up with the most modern devices for extremely delicate electrical measurements, and is the standardizing centre for all electrical instruments on the Pacific Coast. The repair shop is equipped with tools to take care of any emergency, and all repairs and alterations are made therein. The great distance from the electrical factories and consequent high freight rates, as well as loss of time in transit, render these precautionary equipments necessary.

A novel feature of the company's plant is a tunnel three feet by six feet, which has been constructed below low tide level, from the station to San Francisco Bay, for providing a supply of water for condensing purposes. The outlay for this finds its justification in the high price at which coal is sold on the Pacific coast.

Summing up, the total boiler capacity of the three stations is 8,500 h. p., the total engine capacity 7,700 h. p. The company has 478 miles of wire in its overhead circuits strung on 4,086 poles, and there are already laid 12¼ miles of Edison underground conduit. The Palace Hotel, of San Francisco, the largest hotel in the world, has recently turned out its isolated plant, and its 7,000 lights will now be supplied with current from station "C." This hotel is the largest individual consumer of electric current supplien from any central station.

A New Water Motor.

We illustrate a compact and sightly water motor manufactured by the Bolgiana Water Motor Company, 415 Water street, Baltimore, Md., which is especially adapted for sewing machines, and a larger size is made for running fans, coffee mills, dental engines, small dynamos and numerous other apparatus requiring a moderate motive power. The motor requires about 15 to 25 pounds water pressure and with complete attachments, including supply hose and four feet of waste pipe, the motor illustrated weighs only 5 pounds, and the larger size referred to 20 pounds. By means of a patent brake cord arrangement the speed of a sewing machine can be regulated as desired or stopped instantly by pressing the foot gently on the machine treadle. By means of the patent rubber, watertight union shown in the cut the supply pipe can be connected with any smooth faucet.

WATER MOTOR.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Nov. 4, 1893.

ELECTRICAL STOCKS, for a good part of the week, furnished a good deal of the activity in two stock markets, Western Union on the New York Exchange, and Westinghouse on the Boston Board. Naturally, individual circumstances are responsible for the activity displayed by these two stocks, but the whole electrical stock list has been sufficiently definite in its tone to demonstrate how responsive this class of stocks has been to the generally improved state of affairs, and that business matters are improving, and wonderfully so, is sufficiently attested by the spread of confidence. What if the speculative stocks here had failed to boom on the ultimate repeal of the Sherman law? That is no correct diagnosis of the situation. It is bettered, and the good feeling marking the advance of the really investment securities shows to what an extent this improvement has gone.

WESTINGHOUSE ELECTRIC has been the subject this week of much good feeling. The recent large orders received by the Westinghouse Electric Company, mention of which was made in these columns last week, has created a most bullish sentiment regarding the securities of this company, and as a result large orders for investment purposes have been placed in both the common and preferred stocks. The company has recently done undeniably well. The contract with the Cataract General Electric Company, of Niagara Falls, by which the electrical apparatus to be run by power from the falls is to be furnished by the Westinghouse company, alone calls for $1,000,000. Moreover, the company has sold, to great advantage, the massive machinery with which it supplied the lights for the World's Fair, to the city of Chicago. All in all, recent developments have gone far to bear out the Westinghouse officials' reputation for strict attention to business, and the strength of both the preferred and common stock is but an echo of a public recognition of this fact.

GENERAL ELECTRIC'S stock market course must in the future be governed more and more by its actual business operations, and this is a step in the right direction, as this thing alone can correctly measure a stock's value. The determination to pay no November dividend removes this factor as a speculative influence, and the uncertainty attending the early resumption of distribution of profits to stockholders is likely to keep the dividend question in the background for quite a little while yet. The company is to-day in a better condition than for many months past. Its floating debt is taken care of: money heretofore distributed in dividends so as to lend a fictitious air of prosperity is rightly to be applied to extension of business and strengthening of resources. Of course, it is likely that the preferred dividend may be paid. It is cumulative, and the amount required to meet it is less than $150,000 per half year. Although the General Electric Company is understood to be working but one-half its capacity, it is doing so at a profit, and it can easily meet this charge. The officials expect a good response to the invitations for subscriptions to the preferred and common stocks of the new tramway and illuminating securities trust. The rights to subscribe given to General Electric stock sold this week at 1.32. It will be remembered that the whole issue of $4,000,000 is underwritten, so that the success of this funding operation, for such it really is, is assured beforehand.

WESTERN UNION was the feature of the whole stock market in the earlier part of the week. As was prophesied in these columns a serious decline has been recorded from the high fig-

ures reached last week. The decline has been simultaneous with the return to this city of Mr. George Gould, and the remark once made in these letters that the 195 Broadway people did not like to see the stock get much over 85 is well borne out. It now seems, despite the desperate encouragement given to hold on, that the deal to put stock above par has completely fallen through. The stock was put up to 93 last week because it was scarce, but the minute big selling orders appeared—and men like W. B. Wheeler, S. V. White and Henry Allen sold it by the thousand shares this week—all the boom went out and down it dropped to its present price. Instrumental in bringing about the decline was the bill introduced on Tuesday in the Senate by Senator Butler to establish a government system of telegraph lines as a part of the postal system. Congress has now adjourned, but it convenes again in December, and the bill is likely to be again introduced. While it does not prohibit the carrying on of the telegraph business by individuals or corporations, its tenor is such as to threaten ruinous competition to private lines.

THE EDISON ELECTRIC ILLUMINATING COMPANY'S STOCKHOLDERS will hold a special meeting on Nov. 20 to act upon the Board of Directors' proposition to issue $1,750,000 worth of bonds, and other questions that may come up before the meeting. The money is to be used in funding operations and for improvements and additions to the plant. A quarterly dividend of 1½ per cent. was paid on the 1st. inst.

THE POSTAL TELEGRAPH COMPANY was, so a rumor during the week had it, to be sold by Mr. William Mackay to the Western Union people. The story came from Chicago, but Mr. Mackay in this city gave absolute and complete denial to it.

THE NEW ENGLAND TELEPHONE AND TELEGRAPH this week declared a dividend of 75 cents per share, payable on Nov. 15 to stockholders on Oct. 31.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Brush Ill., New York	50	20	40
Detroit Electrical Works	10	2	3
East River Electric Light	100	..	65
Electric Con. & Supply Co. pref.	15	15	16
" " " " com	15	15	17½
Edison Electric Ill., New York	100	97	98
" " " 1sts	...	104	105
Edison Electric Ill., Brooklyn	100	90	95
" " " Boston	100	115	124
" " " Chicago	100	220	230
" " " Philadelphia	100	120	125
Edison Electric Light of Europe	..	2½	5
" Bonds	..	80	85
" Ore Milling	..	5	12
Fort Wayne Electric	..	4	5
General Electric Company	100	45¼	45½
" " deb. 5's	..	79½	80
Interior Conduit and Ins. Co	100	25	35
Mount Morris Electric	..	..	65
Westinghouse Consolidated	50	24½	25½
" pfd	50	40	42
Cleveland General Electric Co	..	85	90
Western Union Telegraph	50	88	88¼

NEW INCORPORATIONS.

THE PEOPLE'S POWER COMPANY, Rock Island, Ill., capital stock $300,000, has been formed to furnish light, heat and power, etc. The organizers are T. B. Davis, S. S. Davis and C. O. Nason.

THE AMERICAN NOVELTY COMPANY, Minneapolis, Minn., capital stock $100,000, has been formed to manufacture electrical and novelty devices. E. N. Darrow, A. F. Pray and T. E. Penney, Minneapolis, Minn., are interested.

THE CRIPPLE CREEK ELECTRIC COMPANY, Cripple Creek, Colo., capital stock $100,000, has been formed to operate an electric plant for furnishing light. R. P. Davie, H. Wilson and W. S. Montgomery, all of Cripple Creek, are interested.

THE MUNCY ELECTRIC LIGHT, HEAT AND POWER COMPANY, Muncy, Pa., has been organized to furnish light, heat and power by generating electricity therefor. E. R. Noble, D. B. Dykins and T. B. Painter, all of Muncy, are the promoters.

THE PULLMAN ELECTRIC COMPANY, Chicago, Ill., capital stock $25,000, has been formed to manufacture, deal in and operate electric machinery and do a general electrical business. F. A. Pullman, David Reid and J. M. Atkinson are interested therein.

THE ELECTRIC MOTOR COMPANY, Duluth, Minn., capital stock $100,000, has been formed to manufacture electric motors and the appliances therefor. The organizers are E. H. Merritt, G. J. Northrup, Marquette, Mich.; F. W. Merritt and A. R. Roe, Duluth, Minn.

THE ROSLYN LIGHT AND POWER COMPANY, Roslyn, Wash., capital stock $17,000, has been formed to manufacture and sell light, heat and power and to do general electric lighting. The promoters are C. A. Sprandel, Mrs. Lena Sprandel and E. C. Sharpe, Roslyn, Wash.

THE CARPENTER ELECTRIC POWER AND LIGHT COMPANY, East St. Louis, Ill., capital stock $2,000,000, has been formed to manufacture and sell electric appliances, etc., and to operate light, power and heat plants. The promoters are C. H. Carpenter, E. C. Dawes and J. A. Brush.

THE MICHIGAN ELECTRIC COMPANY, Detroit, Mich., capital stock $10,000, has been formed to manufacture and sell electrical appliances and to engage in electrical engineering. The incorporators are G. A. Mansfield, J. E. Lockwood, Detroit, Mich., and F. B. Stockbridge, Kalamazoo, Mich.

THE HULINGS ELECTRIC COMPANY, East Liverpool, O., capital stock $25,000, has been formed to manufacture electrical supplies, wire buildings and to do electric lighting, etc. The interested parties are M. A. Hulings, A. R. Walton, S. W. Durkee, T. W. Stevenson and W. P. Gardner.

THE LE ROY ELECTRIC LIGHT, POWER AND HEATING COMPANY, Le Roy, Ill., capital stock $10,000, has been formed to supply electric light, heat and power in Le Roy and vicinity. L. A. Crumbaugh, A. J. Keenan, L. A. Reynolds, Amos Rutledge and S. D. Van Deventer are the promoters.

THE CONNECTICUT ROYAL ARC COMPANY, Elizabeth, N. J., capital stock $500,000, has been formed to manufacture, operate and deal in apparatus for producing and transmitting light by means of electricity. G. H. Squires, Plainfield; F. C. Marsh, Elizabeth, N. J.; A. Bellamy, C. B. Harris and A. H. Patterson, New York City, are the interested parties.

THE NORTHFIELD LIGHT, HEAT AND POWER COMPANY, Northfield, Minn., capital stock $20,000, has been formed to manufacture and sell electricity for light, heat and power, etc. J. W. Hilliard, J. C. Nutting, M. W. Skinner, A. W. Norton, D. J. Ferguson, C. A. Drew, B. Kelly, J. S. Tripp, H. O. Dilley and F. J. Wilcox, Northfield, are the organizers.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Nov. 6, 1893.

MR. W. H. FLEMING is wiring the new pier at the foot of Vesey street.

MR. GEORGE F. PORTER, secretary of the National Electric Light Association, has returned from the West.

MR. G. W. MILLER, representing the New York Carbon Works, will start on a two-weeks' trip West the first of the week.

THE MAYOR will soon appoint three members of the Board of Electrical Control to succeed Jacob Hess, Theodore Moss and Walton Storm.

MR. GEORGE P. WAIDE, general manager of the Northern Electric Supply Campany, Concord, N. H., was in town during the present week, to purchase large amounts of material for railway work.

THE VARLEY DUPLEX MAGNET COMPANY has removed from 136 Liberty street to 64 Cortlandt street to obtain larger facilities. Mr. Richard Varley, Jr., recently returned from the West, where he completed arrangements for the establishment of agencies in the principal cities.

MR. F. B. SHARP, manager of the Brooklyn Electric Manufacturing Company, 286-290 Graham street, Brooklyn, N. Y., reports that his plant is and has been during the past so-called hard times running to its utmost capactiy. Of late this company have been obliged to work overtime trying to keep abreast of orders. They are now receiving orders for their new B. & S. quick break switch, just patented.

MR. G. H. ALMON, for the past seven years with the T. H. and General Electric Company, has established an office in the Electrical Exchange Building, 136 Liberty street, as selling agent for the Belknap Motor Company and the L. P. & D. Power Transmitter Company. Mr. Almon has recently been a construction superintendent of the General Electric Company, of the Excelsior Electric Company's exhibits at the World's Fair.

GENERAL MANAGER W. D. SARGENT, of the New York & New Jersey Telephone Company, says that an effort will be made to establish pay station telephones in barrooms and drug stores, so that the company will get paid for its service, as the proprietors of these places in most instances charge the public for the use of their telephone, which is rented for private use only. Mr. Sargent denied that an effort is being made or is to be made to raise the telephone rates in any other way.

THE BROOKLYN BOARD OF ALDERMEN has, by a vote of 12 to 4, refused to grant a franchise to the State Electric Light and Power Company to operate its plant in that city. The refusal was based on the report of the Committee on Lamps and Gas, signed by Aldermen McGrath, Wafer and Jordan, Aldermen Heaney and Hess refusing to sign the report. The reason given for denying the application of this company was that if the franchise were granted a number of poles would have to be erected in the city, on which wires would be strung, carrying a heavy electrical current, which would be a menace to public life. The city is now lighted by two companies, controlled by politicians. In his application Noah L. Cocheu, president of the State Electric Light Company, offered to light the streets of Brooklyn for 20 per cent. less than the charge of the companies which are now lighting the streets, and to pay the city $10,000 for the privilege. This is the same company that for years has been refused a franchise, in the interests of politicians, it is generally believed.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
36 MONADNOCK BUILDING, CHICAGO, Nov. 4, 1893.

THE CHICAGO ELECTRIC CLUB will hold a meeting at the club rooms, 175 Clark street, Friday, Nov. 10. This meeting is called by the board of managers for the purpose of considering the financial condition of the club and taking such action as is deemed desirable.

MR. GEORGE O. FAIRBANKS, who was for a long term of years the manager of the Westinghouse Electric and Manufacturing Company, in Chicago, has connected himself with the Railway Equipment Company, particularly with a view of taking charge of the agency for the Holmes, Booth & Haydens wire, which has lately been given to this company.

THE JENNEY ELECTRIC MOTOR COMPANY reports a very successful week at its Chicago office for the week ending Oct. 28, Mr. A. H. Goode, agent, having closed contracts for the following apparatus, viz., one 30-kw., 125-volt generator; one 6-h. p., 110-volt motor; one 1-h. p., 110-volt motor; one 5-kw., 125-volt generator; one 300-ampere electro-plating dynamo; one 10-kw., 110-volt generator; one 25-h. p., 500-volt motor; one ½-h. p., 110-volt motor.

News of the Week.

ELECTRIC LIGHT AND POWER.

TREMONT, ILL.—The town of Tremont is to have an electric light plant.

LADD., ILL., has issued plans and specification for an electric lighting plant.

FREELAND, PA.—It is stated on good authority that an electric light plant will soon be installed.

SWEETWATER, TENN.—The Sweetwater Mill Company proposes to put in an electric lighting plant.

CHATTANOOGA, TENN.—The Mountain City Mills contemplate putting in an electric lighting plant.

ELDON, IA.—A company is seeking a franchise to establish a gas plant and also an electric franchise.

PEORIA, ILL.—The bursting of the flywheel in the plant of the General Electric Company caused $15,000 damage.

HUMBOLDT, TENN.—The city voted to issue $10,500 in bonds for a system of water-works and an electric light plant.

COTTAGE CITY, MARTHA'S VINEYARD, has received a proposition from H. S. Kemp to build an electric lighting plant.

HARTSVILLE, CONN.—It has been decided by local capitalists to use the water power here for an electric lighting plant.

PLEASANT HILL, MO.—Mr. Robert Lee, of the Silver Lake woolen mill, is at the head of a movement to purchase an electric lighting plant.

CRESCENT HILL, KY.—The heating and lighting plant of the St. Joseph German Orphan Asylum was burned. Rev. P. J. Haeseley is in charge.

EMERSON, IA.—A new flour mill is to be erected, and there is talk of an electric light plant being established in connection with the milling plant.

JEFFERSON, IA.—F. M. Riley, of Jefferson, is considering the building of an electric light plant, to light also Madrid, Ames and other nearby cities.

GEO. F. BLASHEK, of Roswell, Chavez County, New Mexico, intends putting in an electric lighting, power and heating plant and wants prices from manufacturers.

KEARNY, N. J.—The clerk of the Township Committee has been instructed to advertise for bids for public electric lighting to be presented Dec. 12, at 9 p. m.

NORTHAMPTON, MASS.—The directors of the Northampton Electric Company held an adjourned meeting in the matter of their proposed new plant. Treasurer Pierce will give details.

GRAND HAVEN, MICH.—The new management of the Grand Haven electric light plant intend to make many improvements in the plant. A new engine and an incandescent system will be placed in the plant.

POTSDAM, N. Y.—F. J. Merriman, A. D. Whitney and A. T. Hepburn, of Madrid, N. Y., are here looking at the local electric plant. They are the committee of Madrid, N. Y., which proposes to put in there an electric lighting plant.

FRESNO, CAL.—A new flouring mill will be built by the Sperry Flour Company, with Harry Sherwood as manager. Among other improvements and modern conveniences will be an electric light plant attached to and run by the mill machinery.

DEERING, ME.—It is stated that the Deering Electric Company, composed of Caleb R. and Pembroke S. Marsh, will begin the erection of a plant for public and private lighting as soon as it can be ascertained that the City Council will adhere to their contract,

BIG RAPIDS, MICH.—Sealed proposals will be received for lighting the city of Big Rapids, Mich., with 32 or more 2,000-c. p. electric lamps, bids to be opened at a meeting of the council to be held Thursday, Nov. 9, 1893, at 7:30 a. m. John T. Clark, recorder.

MIDDLEBORO, MASS.—Middleboro, in town meeting, has voted, by 610 to 116, in favor of purchasing the plant of the Middleboro Gas and Electric Light Company and issuing bonds for same to amount of $75,000. Hawley Pettibone and Henry Legate will give details.

TOPEKA, KAN.—The Board of Public Works opened the bids for the electric light contract at the Deaf and Dumb School at Olathe. Five bids were filed but all were thrown out on account of irregularities. They will advertise immediately, and hope to let the contract within 30 days.

OELWEIN, IA.—The New Hampton firm, to whom the franchise was granted, find, owing to the financial stringency, that they will be unable to perform their part of the contract in the time allotted to them, so that the city will either have to extend the time or look elsewhere for some one to take hold of it.

COLFAX, ILL.—Colfax is figuring on putting in an electric light plant. A Peoria firm proposes to put in the plant and run it if it can get the franchise or will sell it to the village at any time. The Council is in favor of the idea, as it believes that enough can be made by furnishing private lights to pay for the plant.

SCRANTON, PA.—The Economy Light, Heat and Power Company has applied for right to lay conduits in the streets here, but the matter has been referred to the Judiciary Committee. They propose to convey light, heat and power, but their application was of too blanket a character to be passed upon without examination.

GREENFIELD, MASS.—The people who have been talking of building a plant for the generation of electricity near the Conway station have made an offer to the Greenfield Electric Lighting Company which was rejected, because the price was too high. It is stated on good authority, however, that a new plant will surely be built.

HAMILTON, O.—At a meeting of the City Council a communication was received from the gas trustees favoring the establishment of an electric system, to be operated in connection with the city gas works. The Council is unanimously in favor of an electric light plant, and in November the people will vote in favor of issuing $50,000 worth of bonds.

THE ELECTRIC RAILWAY.

SPRINGFIELD, MASS.—The Springfield Street Railway Company proposes to erect next year a $150,000 power house.

TEWKSBURY, MASS.—The selectmen have granted a franchise to the Lovell & Suburban Street Railway Company.

BALLSTON, N. Y.—The matter of an electric road between Ballston and Rock City Falls and Middle Grove is being agitated, but no definite steps have been made.

ALEXANDRIA, VA.—A bill granting the Mount Vernon Electric Railroad the right to furnish the citizens with electric power has been passed in the House of Representatives.

SOUTH BETHLEHEM, PA.—The Lehigh Valley Traction Company, of which John K. Page is secretary-treasurer, has been given right to lay rails, and work has been begun.

BERLIN, CONN.—The New Britain Central Electric and Railway Company will, early in the spring, begin the work of extending their line to Berlin. F. G. Platt is president and treasurer.

NORRISTOWN, PA.—The Philadelphia "Record" repeats the statement that the movement is gaining to change the Stony Creek to a trolley road. It now runs to Lansdale, a distance of 10 miles.

ADRIAN, MICH.—The sale of Adrian's Electric Belt Railway to S. D. Nesmith, as agent of the Thomson-Houston syndicate, has been perfected. The electric line is sure to go to Tecumseh and Ypsilanti.

CAMBRIDGE, MASS.—The Railroad Commissioners have granted the petition of the West End Street Railway Company

to establish a trolley line on certain streets, excepting Brattle and Craigie streets.

NIAGARA FALLS, N. Y.—The Hon. W. Caryll Ely states that as soon as right of way can be secured the proposed electric line to Buffalo will be built. They have been hampered by non-consents and the tightness of the money market.

RICHMOND, VA.—The Richmond Railway and Electric Company propose to erect a larger power house on Brown's Island, and they will move there the machinery now in the power house on Seventh street and put in additional new machinery.

TARENTUM, PA.—J. C. Whitla and others, of Beaver Falls, Pa., who owned the franchise for an electric street railway between here and New Kensington, have sold the same to Messrs. Hussey, Rafferty & Dravo, of Pittsburgh, who will at once begin work on the line.

SANBORN, N. Y.—Hon. Lee Sanborn states that the proposed road to Tonawanda has not been abandoned, but that owing to the financial stringency the company has found it difficult to raise money. He states that immediate steps toward the building of the road will be taken.

BETHLEHEM, PA.—Colonel Campbell, president of the Bethlehem & Allentown Rapid Transit Company, states that they contemplate four extensions in the immediate future. The South Bethlehem line is to be extended to the borough limits, a line is to be built in Main street in Bethlehem in the spring and finally a belt line will be built around Bethlehem, to include the fair ground.

HAVERHILL, MASS.—A committee has been chosen of the various parties interested in the proposed great trolley system for Haverhill and the various cities in southern New Hampshire, and they will report at a meeting to be held soon in the Board of Trade rooms here. President Sanders, of the Haverhill Board of Trade, and ex-City Solicitor Fuller, are interested. Wm. T. Morse, of Derby, N. H., and G. W. Dobbins, of Plaistow, N. H., are also interested.

PERSONAL NOTES.

MR. W. F. C. HASSON has been selected as electrical engineer to supervise the purchase and installation of an electric plant at Pomona, Cal., for the purpose of furnishing light and power to Jackson, Sutter and Amador, Cal.

MR. SAMUEL LITTLE was elected on Oct. 25 as the successor of Mr. H. M. Whitney in the presidency of the Boston West End Street Railway Company. Mr. Little has long been identified with the street railway and gas interests of Boston, as well as with several of its great manufacturing concerns. He is a trustee of the Roxbury Institution of Savings and one of the incorporators of the Roxbury Homeopathic Dispensary, and for many years took an active part in public life, having held a number of offices, including representative to the State Legislature.

MISCELLANEOUS NOTES.

ELECTRIC SUBWAYS.—Kansas City, Mo., is considering the question of building subways and renting the use of them to telephone and other electric companies.

ELECTRIC ORGANS.—St. Teresa Church, Brooklyn, has two organs, both of which are operated from one electric keyboard. Garden City, L. I., has four organs operated in this manner.

THE NEW YORK TELEGRAPHERS' DRAMATIC AND LITERARY ASSOCIATION will give their second annual entertainment and reception at the Central Opera House, 215 East Sixty-seventh street, New York, on Thursday evening, Nov. 16.

THE NEW YORK STATE RAILWAY COMMISSIONERS have had under consideration for some time the electric railway systems of the State, their purpose being to obtain information necessary to enable them to pass intelligently upon the question of regulating the speed of cars in thickly inhabited districts, and to offer suggestions regarding safety appliances.

MR. H. W. FRUND, superintendent of the Vincennes (Ind.) Electric Light and Power Company, has issued a pamphlet giving in detail the many advantages of the electric light as an illuminant, with some other information for the benefit of users. Mr. Frund will be pleased to send a copy of this to any one on application, which generous offer should be taken advantage of by station managers and superintendents.

THE BUFFALO ELECTRICAL SOCIETY held its annual meeting last week. The treasurer's report showed a balance of $152.88, and the librarian reported that the library contained 75 copies of standard electrical works, 66 volumes of electrical periodicals bound, and a quantity of experimental apparatus. The Society is just entering on its eleventh year. The following officers were elected for the ensuing year: President, Philip K. Stern; vice-president, Frank C. Perkins; secretary, Astley C. Terry; treasurer, Samuel Stewart; librarian, John G. McNerny; executive committee, Frank Kitton, Geo. A. Burnett, C. B. Boughton. At the next meeting, on Nov. 19, President Stern will read a paper on "Electricity at the World's Fair."

WHO ARE THEY?—The Washington "Star" takes as texts for an editorial against the "deadly trolley" the opinions of two Philadelphia electricians, from which we extract the following: "Should the insulation on the feed wires of the trolley lines become broken off by wind storms, the iron poles would immediately become charged with electricity, as iron is a good conductor." "No man can stand a shock of 500 volts, and many nothing like that pressure. Besides, water is an excellent conductor, and electric fluids charge more quickly during rainstorms." "It is useless to try to make people believe that electricity is not dangerous, for it is under any conditions at present." "The danger of coming in contact with poles is not the only one. When the overhead wire is in operation there will be danger of the current being communicated through the water pipes and gas pipes right in our houses, so that it would be dangerous to turn on the gas." The editor asks if, in view of these opinions, Washingtonians should be glad that there are corporations willing to inconvenience and endanger the public in this manner that corporative profit may accrue.

Trade and Industrial Notes.

THE BELKNAP MOTOR COMPANY proposes to remove from Portland to land of Woodbury K. Dana, at Westbrook, Me., and they will build there a four-story factory, to be 40 by 80. No plans have yet been made or contracts let.

MR. G. H. ALMON, 136 Liberty street, New York, manager of the Belknap Motor Company, has recently sold a 60-light plant complete to Messrs. Bogle & Scott, New York, and also a 25-light plant complete to the Lanesboro Mills, Lanesboro, Vt.

THE TURNEY MANUFACTURING COMPANY, Chicago, has issued a large cardboard sheet, containing illustrations of the dental specialties manufactured by it, consisting of dental motors and engines, the Crowdus battery, and dental tools of various kinds.

THE CADMUS ELECTRIC MANUFACTURING COMPANY, of Elkhart, Ind., has enlarged its manufacturing capacity in order to handle its increasing transformer trade. It is receiving some very fine indorsements on the merits of its improved transformers.

THE ANSONIA ELECTRIC COMPANY.—J. B. Wallace, receiver of the Ansonia company, has offered to settle the indebtedness of the company on a basis of 60 cents on the dollar. Most of the creditors have agreed to the settlement. The assets of the company are $300,808.92. and the liabilities $342,000,000.

THE NEW YORK KNIFE COMPANY, at Walden, N. Y., are building a new fireproof storehouse to be 28 feet in width and 100 feet in length. The side walls will be of brick and the roof of iron, designed and built by the Berlin Iron Bridge Company, of East Berlin, Conn., covered with their well known anti-condensation iron.

A. V. SCHOONMAKER, 158 William street, New York, calls our attention to an error in these columns last week, the printing-office having transformed "India mica" into "india rubber mica." As Mr. Schoonmaker's confidence in India mica alone is so well known, doubtless some of our readers may have been surprised to read that he had taken up such a mysterious material as india rubber mica in its stead.

THE NEW YORK AND OHIO COMPANY announce that their factory is again in full operation. They now have ready for the market their "New Style" 16 c. p. lamps, on which they have taken out several patents. About twenty more have been applied for. This is an entirely new and novel method of making incandescent lamps, which it is claimed does not infringe any patents, while it secures many advantages not heretofore enjoyed by the lamps manufactured under old patterns.

THE SAFETY NAVAL MARINE INSULATED WIRE, manufactured by the Safety Insulated Wire and Cable Company, with factories at 232 to 242 West Twenty-ninth and 227 to 239 West Twenty-eighth streets, New York, has been tested and approved by the Naval Bureau of the United States government, and during the past two years has been used in the installation of the following new war vessels: New York, Cincinnati, Texas, Raleigh, Bancroft, Marblehead, Columbia, Miantonomoh, Olympia and Oregon.

THE ELECTRIC APPLIANCE COMPANY reports that it is again in the market with Packard lamps, and has already filled a number of very large orders. It reports that the merits of the Packard lamps are so well appreciated by its customers that the mere announcement that it is again prepared to furnish them in quantities causes the orders to come in in a manner that is extremely pleasing not only from a business point of view, but also from the confidence which is thus evidenced in its leading specialty.

THE M'CREARY ELECTRICAL SPECIALTY COMPANY, 136 Liberty street, New York, has issued a neatly printed illustrated leaflet, setting forth in a concise manner a few of its latest specialties. Mr. McCreary has recently received some large orders from England, and also from South America, which, together with their large and increasing trade in the United States, has kept this company exceedingly busy during the past six months. The company will shortly place upon the market a line of ornamental devices for the comfortable use of the incandescent electric lamp, particularly suitable for holiday offerings.

THE ELECTRICAL AND MANUFACTURING COMPANY, of Pittsburgh, has received a large order for new power machinery from an electric power company at Pomona, Cal. It has been successfully operating for some time past a circuit 32 miles in length, on which are located three cities, to which it is furnishing power. It is going to extend its circuit 30 miles, and the new machinery is to provide for the increased demands by reason of this extension. This California company secures its power in much the same manner as the Cataract Power Company at Niagara Falls.

MR. CHARLES WIRT, formerly engineer of the Ansonia Electric Company, has opened an office as consulting engineer at 56 Fifth avenue, Chicago. He will make a specialty of incandescent lighting work. Mr. Wirt has had a very valuable experience in this field, going back to the days when the experimental stage was still unfinished. The numerous articles in common use bearing the name of "Wirt" are a witness to his good judgment in matters electrical, and appreciation of commercial demands. Constructors, inventors and capitalists all have frequent need of the services of just this class of talent, and we regard it as one of the hopeful signs of the times that it is no longer necessary to go to the large companies to find the best specialists.

THE CONSOLIDATED CAR HEATING COMPANY, of Albany, N. Y., held a special directors' meeting on Tuesday, Oct. 31, and the final papers were signed transferring to an English syndicate the English steam and hot water heating patents of the Consolidated Car Heating Company. The English electric heating patents have not yet been taken by the English syndicate, although it has an option thereon until Jan. 1, 1894. The option on the heating patents which it bought would have expired Nov. 1. The total sales of the Consolidated Car Heating Company, including October complete, are slightly in excess of the sales at the same period last year. Within the last week orders for electric heaters have been received from 21 additional roads, making a total of 51 street railways in the United States and Canada which are using or are about to use the Consolidated Company's electric heaters.

THE FITCHBURG STEAM ENGINE COMPANY, of Fitchburg, Mass., has been running full time with a full force, and part of the time within three months all night or until 9 o'clock, and has work in hand for another month at least. They are now shipping two 350-h. p. tandem compound condensing engines to the Oakland Gas and Electric Light Company, California, and have just sent a 250-h. p. cross compound to the North Adams Electric Light Company (second engine); also a 100-h. p. low speed horizontal for electric lighting for Washington, D. C. Among the larger engines erected within three months are a 700-h. p. triple expansion in a Pennsylvania paper mill; a 500-h. p. cross compound for R. Hoe & Co., of New York; a 150 h. p. and two 75 h. p. for sugar refinery at Yonkers, N. Y. They are building a large tandem compound for the municipal lighting plant of Attleboro, Mass.; two cross compound 300 h. p. for Boston, Mass.; a 350-h. p. cross compound for the Columbia Electric Light Company, Pennsylvania; a 100 h. p. for Eastern Electric Cable Company, Boston, and several others. Two-thirds of their work for the past year has been for parties who have used their engines from 3 to 13 years, a good testimonial of their excellence.

QUEEN & CO., INCORPORATED.—Queen & Co., incorporated, Philadelphia, express themselves as exceedingly pleased with the large orders obtained as a result of their extensive World's Fair exhibits. In addition to commercial instruments they find a steadily increasing demand for the standard electrical apparatus which they manufacture with the greatest precision, and a number of the principal colleges have purchased extensively for laboratory equipments. Among these may be mentioned Armour Institute, Chicago; University of Chicago, Chicago; Case School of Applied Science, Cleveland, Mass.; Institute of Technology, Boston; University of Iowa, Iowa City; University of Minneapolis, Minneapolis; Alabama A. and M. College, Auburn; Colgate University, Hamilton, N. Y.; Rensselaer Polytechnic Institute, Troy, N. Y.; Adelbert College, Cleveland; University of Wisconsin, Madison; Western University of Pennsylvania, Allegheny; University of Tennessee, Knoxville; University of Nebraska, Lincoln; Northwestern University, of Evanston, Ill.; University of Notre Dame, Indiana; University of Illinois, Champaign, etc. Seven separate awards have been granted to Queen & Co. in the Department of Electricity, so that it is evident the high quality of their product was appreciated by the Board of Judges.

THE BABCOCK & WILCOX COMPANY, 30 Cortlandt street, New York, placed on the front of their boilers at the World's Fair during the last few weeks of the fair the following notice: "Special Notice!—These boilers have received no Award. Why? Read! Learn! We are informed that is was the purpose of the jury to make awards on boilers based entirely upon the written statements of the exhibitors of boilers, without tests or any personal knowledge in the possession of said jury concerning the comparative construction, operation, economy or durability of said boilers. We were asked to make such a statement, and were informed that all other exhibitors of boilers had been requested to make a like statement of their claims for the consideration of the Jury of Awards. Believing that an award based on such insufficient knowledge on the part of said jury could be of no practical value, and notwithstanding the expense incurred by this company in making an exhibit, we respectfully declined to make any such written statement for the purpose of receiving an award upon our boilers. While we do not in the least envy those who have, upon such knowledge by the jury, been awarded premiums, we are equally content to stand upon the record without an award based on such a knowledge of our goods." The World's Fair system of awards seems to have been devised with little regard as to what an award should represent, and this is particularly true of classes of exhibits like the above.

A COMPUTING MACHINE.—The Felt & Tarrant Manufacturing Company, 32 Illinois street, Chicago, Ill., has issued a pamphlet descriptive of their Comptometer, a machine for arithmetical computations operated by keys like a typewriter. By means of this ingenious machine quantities of eight numbers, and with large sizes even more, can be added, divided and multiplied, the entire operation being merely mechanical. There is a series of keys for each column of numbers, and the numbers upon the keys arranged as they are ordinarily written, units to the right, tens next to the left, and so on; from this it will be seen that the operator does not have to jump around from one part of the keyboard to the other, but always works in a straight row, only passing from one key to its neighbor. Operations can be performed exceedingly rapidly; for instance, the example 614 × 342 can be performed by an ordinary operator in four seconds, while an expert operator can perform it in 2½ seconds. The machine has already come into considerable use, and among recent testimonials, one from the Edison Illuminating Company, of Paterson, N. J., states that work formerly requiring three days is now done with a Comptometer in one day. The Utica Electric Light Company says that a bookkeeper with ordinary practice on the comptometer can take the place of two men in any business office, and the Milwaukee Gas Light Company says it has found the machine invaluable, and that it is in almost constant use by some member of their office force, and has paid for itself several times over.

THE PROVIDENCE STEAM ENGINE COMPANY, manufacturers of the Greene-Corliss engine, have installed at the mill of the Rotch Spinning Corporation, New Bedford, Mass., a 550-h. p. triple expansion engine, for which power three boilers had been put in. The Greene engine, however, only requires one of these. This company recently contracted, and is now building for the same company another triple expansion engine of 600 to 700 h. p., and in the same city has recently placed engines of the compound type for the Hathaway Mills, 1,500 h. p.; for the New Bedford Gas and Edison Electric Light Company, 600 h. p, and New Bedford Manufacturing Company, 600 h. p. It has recently put in operation for the Globe Mills, Woonsocket, a compound engine of 1,200 h. p., and is now engaged in the construction of a compound engine for the Social Mills, also of Woonsocket, 500 h. p. The company recently completed and is now engaged in the construction of compound engines for the Albany Electric Illuminating Company, 400 h. p.; for the Winchester Repeating Arms Company, 500 h. p.; the Industrial Improvement Company, 1,000 h. p.; Washburn & Moen Manufacturing Company, 400 h. p., and of simple condensing and non-condensing engines: Parsons Paper Company, 800 h. p.; Thomas Potter, Sons & Co., Philadelphia, 400 h. p.; West End Electric Company, 500 h. p.; Peace Dale Manufacturing Company, 250 h. p.; Riverside Paper Company, Holyoke, 350 h. p.; National Carbon Company, Cleveland, O., 900 h. p.; League Island Navy Yard and Charleston Navy Yard, 250 h. p.; Lee, Holland & Co., Buffalo, 800 h. p.; S. A. Crozer & Son, Chester, Pa., 500 h. p., and some 40 engines varying from 75 to 250 h. p. The demand for the engines has required an enlargement of the works, and every available inch of ground is now covered with buildings to provide for the constantly increasing demand. Among new appliances are several electric cranes, capable of handling from 15 to 25 tons, and with the railroad tracks, which have been led into the erecting shops, the cars can be loaded with the machinery inside of the works, thus saving a great deal of extra labor and delay which occurred in the cartage across the city and waiting for cranes at the railroad freight stations. At the dock there are a pair of shear-poles for shipment by water, with which 100 tons can be handled if necessary. New machinery of most improved patterns has been purchased, and the facilities for construction are equal to those of any other works of the same character in the country.

Business Notices.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N.Y.